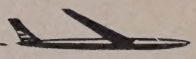
DOPPLER NAVIGATION COMPUTER SYSTEM NC-103

TEST SET 578L-1



INSTRUCTION BOOK

488A-1 included

COLLINS RADIO COMPANY

GUARANTEE

The equipment described herein is sold under the following guarantee:

Collins agrees to repair or replace, without charge, any equipment, parts, or accessories which are defective as to design, workmanship or material, and which are returned to Collins at its factory, transportation prepaid, provided

(a) Notice of the claimed defect is given Collins within one (1) year from date of delivery and goods are returned in accordance with Collins instructions.

(b) Equipment, accessories, tubes, and batteries not manufactured by Collins or from Collins designs are subject to only such adjustments as Collins may obtain from the supplier thereof.

(c) No equipment or accessory shall be deemed to be defective if, due to exposure or excessive moisture in the atmosphere or otherwise after delivery, it shall fail to operate in a normal or proper manner.

Collins further guarantees that any radio transmitter described herein will deliver full radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.

The guarantee of these paragraphs is void if equipment is altered or repaired by others than Collins or its authorized service center.

No other warranties, expressed or implied, shall be applicable to any equipment sold hereunder, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements in this paragraph contained. In no event shall Collins have any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment or materials, or from any other cause.

HOW TO RETURN MATERIAL OR EQUIPMENT. If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. If the item is thought to be defective, such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. (With respect to tubes we suggest that your adjustments can be speeded up if you give notice of defect directly to the tube manufacturer.) Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in the handling of your returned merchandise.

ADDRESS:

Collins Radio Company
Service Division
Cedar Rapids, Iowa

INFORMATION NEEDED:

(A) Type number, name and serial number of equipment
(B) Date of delivery of equipment
(C) Date placed in service
(D) Number of hours of service
(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
(H) Item or symbol number of same obtained from parts list or schematic
(I) Collins number (and name) of unit subassemblies involved in trouble
(J) Remarks

HOW TO ORDER REPLACEMENT PARTS. When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable. To enable us to give you better replacement service, please be sure to give us complete information.

ADDRESS:

Collins Radio Company
Service Division
Cedar Rapids, Iowa

INFORMATION NEEDED:

(A) Quantity required
(B) Collins part number (9 or 10 digit number) and description
(C) Item or symbol number obtained from parts list or schematic
(D) Collins type number, name and serial number of principal equipment
(E) Unit subassembly number (where applicable)

INSTRUCTIONS FOR

520-5952-00
2nd EDITION, 15 JULY 1961

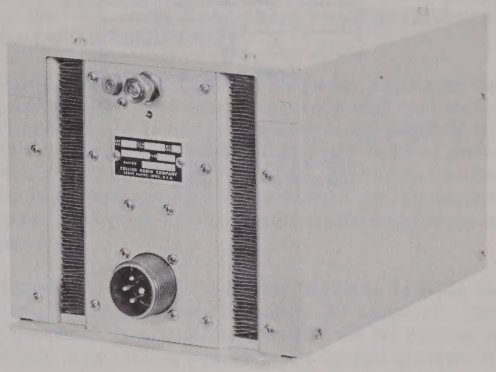
COLLINS INVERTER 488A-1

1.1 GENERAL DESCRIPTION.

Collins Inverter 488A-1 is a transistor power supply that converts 27.5-volt, d-c power to 115- and 26-volt, 400-cycle-per-second power. Refer to figure 1.

1.2 SPECIFICATIONS.

Power source . . .	27.5 volts d-c, 4 to 25 amp (depending on load). Unit will stand 65-volt transients on supply line.
Output	115-volt, 400-cps, continuous output of 250 va up to +55°C and continuous output of 170 va up to +70°C. Output regulated to within ±10 percent. Frequency regulated to within ±5 percent.
	26-volt, 400-cps, continuous output of 140 va. Do not exceed 250 va total load on the 488A-1.
Efficiency	60 percent.
Ambient temperature	-40°C to +70°C.
Ambient humidity . .	Up to 95 percent humidity at 50°C.
Altitude	Normal operation up to 10,000 feet at +70°C, higher altitudes at reduced temperatures or loads.
Shock conditions . .	Per RTMA paper 100-54/DO-60 except where angles are called out as 45°; use 90°.
Vibrations	Per RTMA paper 100-54/DO-60.
Transistor complement	2-2N414 . . 1-oscillator; 1-voltage regulator 2-2N45 . . . Preamplifiers 2-DT4-17 . Drivers 8-2N174 . . Power amplifiers 14 Total



C445-05-P

Figure 1. Collins Inverter 488A-1

2.1 INSTALLATION.

The 488A-1 is base-plate mounted and requires no shockmount. Refer to figure 2 for mounting details. The over-all dimensions are 5-39/64 inches high by 6-23/32 inches wide by 9-25/32 inches long; weight is 9.25 pounds.

2.2 INTERCONNECTING WIRING.

Interconnection of the unit consists of making input and output voltage connections and providing a common ground lead between the unit and the equipment to be used.

3.2 OPERATION.

Operation of Inverter 488A-1 is controlled by the application of 27.5-volt, d-c power.

4.1 PRINCIPLES OF OPERATION. (Refer to figure 3.)

Transistor Q1 is a self-excited oscillator whose frequency is controlled by C1 and C2 in parallel with variable inductor L1. The output voltage of Q1 is determined by the collector voltage which is controlled by voltage regulator transistor Q2. Conduction level of Q2 is set by a rectified 400-cycle voltage from variable resistor R7. Since the 400-cycle voltage for the rectifier circuit is derived from the power supply

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1959, 1961

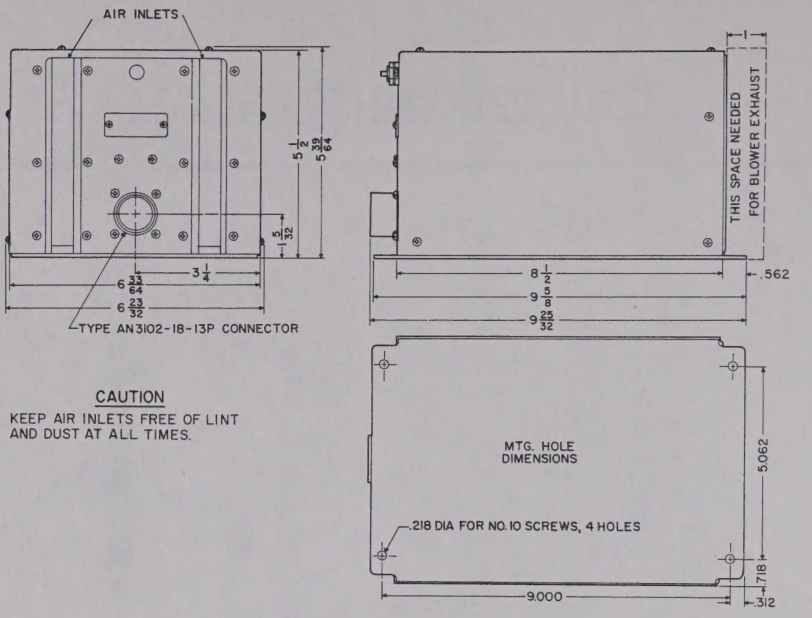


Figure 2. Outline and Mounting Dimensions

output circuit, any fluctuations in output voltage are sensed by the rectifier circuit, amplified by the voltage regulator Q2, and corrected by increased or decreased output from oscillator Q1.

The 400-cycle output voltage from Q1 is transformer coupled to a push-pull isolation amplifier stage consisting of transistors Q3 and Q4. Transistors Q3 and Q4 amplify the 400-cycle signal for application to the driver stage. A transient blanking circuit, made up of Zener diode CR1, R10, and R15, cuts off transistors Q3 and Q4 when a positive transient appears on the input voltage line. Note that the oscillator is not affected by the transient blanking circuit but will continue to oscillate. When the transient voltage subsides, Q3 and Q4 are turned on again.

The output from the amplifier stage is coupled to a class B, push-pull, audio amplifier stage made up of transistors Q5 and Q6. In transformer T3, a feedback winding in the base circuit of each half of the class B amplifier is used to allow a common-emitter type of operation with a grounded-collector type of circuit configuration. The windings of transformer T3 have a 1:1 ratio and serve as an isolation means that allows the input signal from T2 to be applied between the emitter and base of transistors Q5 and Q6 while permitting the emitters to "swing" with respect to the secondary of transformer T2.

Output from Q5 and Q6 is coupled to transformer T4 and drives four, parallel, class B, push-pull power amplifier stages. The power amplifier circuits are identical to the driver amplifier circuit. Additional transient protection is applied to the base circuits of the driver and power amplifiers through capacitors C16, C17, C18, and C19. Line transients are applied directly to the base circuits of transistors Q5 through Q14, thus cutting them off, while line transients to the emitter circuits are delayed by capacitors C11 and C12.

Two 400-cycle outputs (115- and 26-volt) are taken from the secondary of T4 and coupled through contacts of relay K1 to plug P1. The coil of relay K1 is in series with the B+ supply for the driver and power amplifier stages. This relay is intended to provide relief from momentary overloads on the power supply. Relay K1 operates whenever excessive current is drawn by transistors Q5 through Q14 causing resistors R18 and R19 to be put in series with the 26-volt and 115-volt outputs, respectively. Sustained overload on the 488A-1 may cause resistors R18 and R19 to be damaged. Blower motor B1 operates automatically whenever the 115-volt output is present.

5.1 MAINTENANCE.

CAUTION

When operating the 488A-1 removed from its case, use an external blower to cool the transistors in the final amplifier stage.

Transistor failure in either the driver or power amplifier stages will appear as a short on the input voltage line. Transistors Q7 through Q14 may be checked by attaching a variable input voltage supply to pin A of P1 and setting the input current to 10

amperes. Then, using a vtvm (negative lead to ground), measure the emitter voltage of each transistor. A low emitter voltage (about 0.05 volt) indicates a faulty transistor. When one or more of the transistors are shorted, normal emitter voltage is about 0.1 volt.

If the emitter voltages on all transistors in either half of the power amplifier stage are low, that is Q7, Q9, Q11, and Q13 or Q8, Q10, Q12, and Q14, then Q5 or Q6 may be faulty. Transistors Q5 and Q6 may be checked using the procedure given for checking transistors Q7 through Q14.

NOTE

If a variable d-c supply is not available, insert two paralleled, 5-ohm, high-wattage resistors in series with the normal 27.5-volt input voltage supply.

Other components of the 488A-1 may be checked by using the voltage and resistance readings given in table 1; replace any faulty components.

Resistor R7 sets the voltage output of the 488A-1 and will likely never need adjustment. Should adjustment be required, attach a 250-va load to pin D of P1, and adjust R7 for a 115-volt a-c indication at test point 1 on the front panel; input voltage should be +27.5 volts d-c for this adjustment.

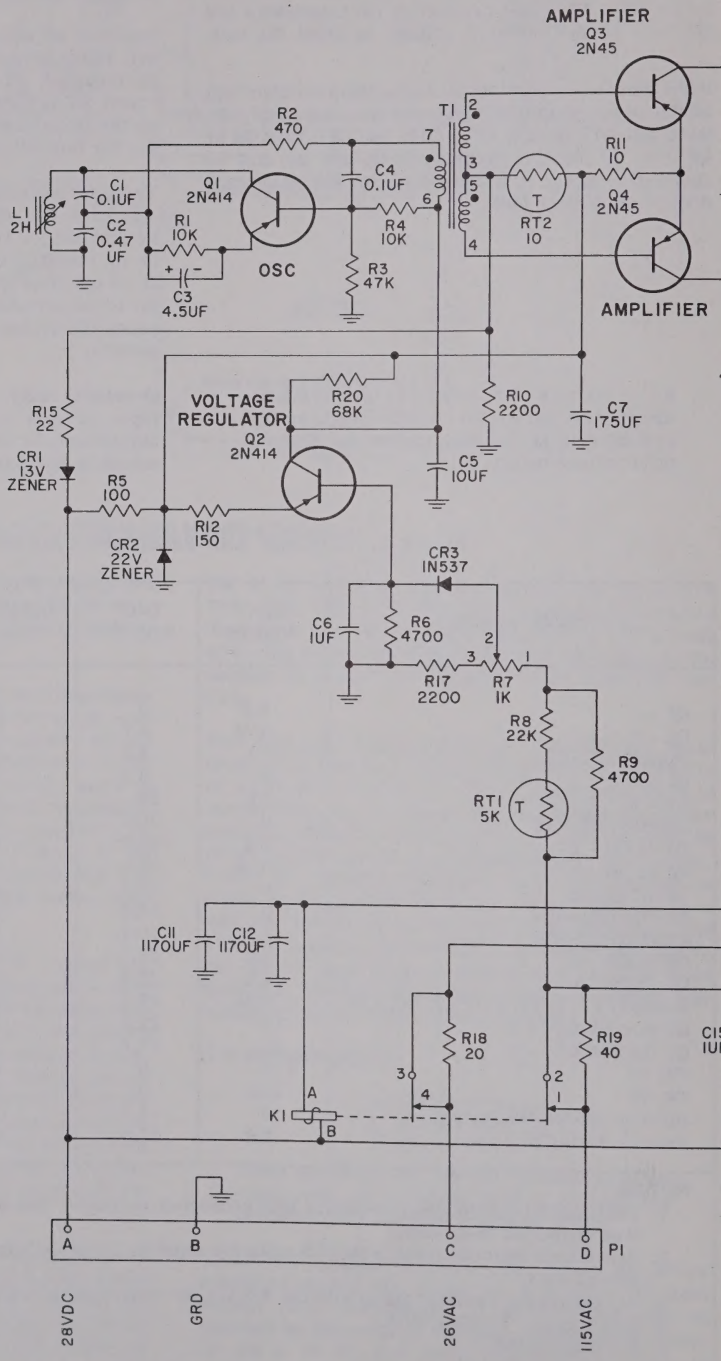
Variable inductor L1 is the frequency adjustment for oscillator Q1. Oscillator frequency may be checked by attaching a frequency counter to the output of Q1, or by coupling the output of Q1 to the vertical plates of an oscilloscope and attaching a good audio oscillator to the horizontal plates. Adjust L1 until the counter reads 400 cycles or the oscilloscope forms a Lissajous pattern.

Overload relay K1 is factory adjusted to limit the input current to approximately 30 amperes. This adjustment is critical and should not be readjusted unless it is certain that K1 is not operating properly.

TABLE 1. VOLTAGE AND RESISTANCE MEASUREMENTS

TEST POINT	A-C VOLTS	D-C VOLTS	RESISTANCE (+) (See note 1.)	RESISTANCE (-) (See note 1.)
Q1 - c	5.8	0	135	
Q1 - b	0.74	6.7	10K	185
Junction C1-C2	1.1	8.2	2K	5.9K
Q2 - c	0	8.3	1.55K	6K
Q2 - b	2.6	24	4.5K	250
Junction R5-R12	0	20.5	175	50
Q3 or Q4 - c	2.4	10.9	160	500
Q3 or Q4 - b	0.18	20.5	170	70
Q3 or Q4 - e	0	20.5	110	52
Junction T1-RT2	0	20.5	170	50
Junction T2-R16	2.2	10.7	160	500
Q5 or Q6 - b	4.6	27.5	200	1.7
Q5 or Q6 - e	4.4	27.5	200	0.9
Junction T2, 6-T3, 1 or T2, 4-T3, 4	0.95	27.5	200	2.2
Q7 through Q14 - b	16	27.5	200	0.5
Q7 through Q14 - e	16	27.5	200	0.5
T4, 17	115	0	3	
T4, 19	25.5	0	0.5	
Junction R7-R8-R9	50	-9.8	2.1K	
Junction C11-C12	0.8	27.5	200	0.45

NOTES:
1. Resistance (+) indicates plus meter lead connected to ground. Resistance (-) indicates minus meter lead connected to ground.
2. All voltage readings taken with 27.5 volts d-c input to the 488A-1 and with the unit terminated with a 250-va load.
3. All resistance readings taken with the 488A-1 not connected to external circuits.
4. Meter used: Triplett 630A.
5. All values ±15%.


AMPLIFIER
Q3
2N45
T1
R2
470
C1
0.1UF
L1
2H
C2
0.47
UF
Q1
2N414
R1
10K
C3
4.5UF
OSC
C4
0.1UF
R4
10K
R3
47K
T
RT2
10
R11
10
Q4
2N45
AMPLIFIER
R15
22
CR1
13V
ZENER
VOLTAGE
REGULATOR
Q2
2N414
R20
68K
R10
2200
C7
175UF
C5
10UF
R5
100
R12
150
CR2
22V
ZENER
CR3
IN537
C6
1UF
R6
4700
R17
2200
R7
1K
R8
22K
R9
4700
RT1
5K
C11
1170UF
C12
1170UF
R18
20
R19
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K1
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B
PI
28VDC
GRD
26VAC
115VAC

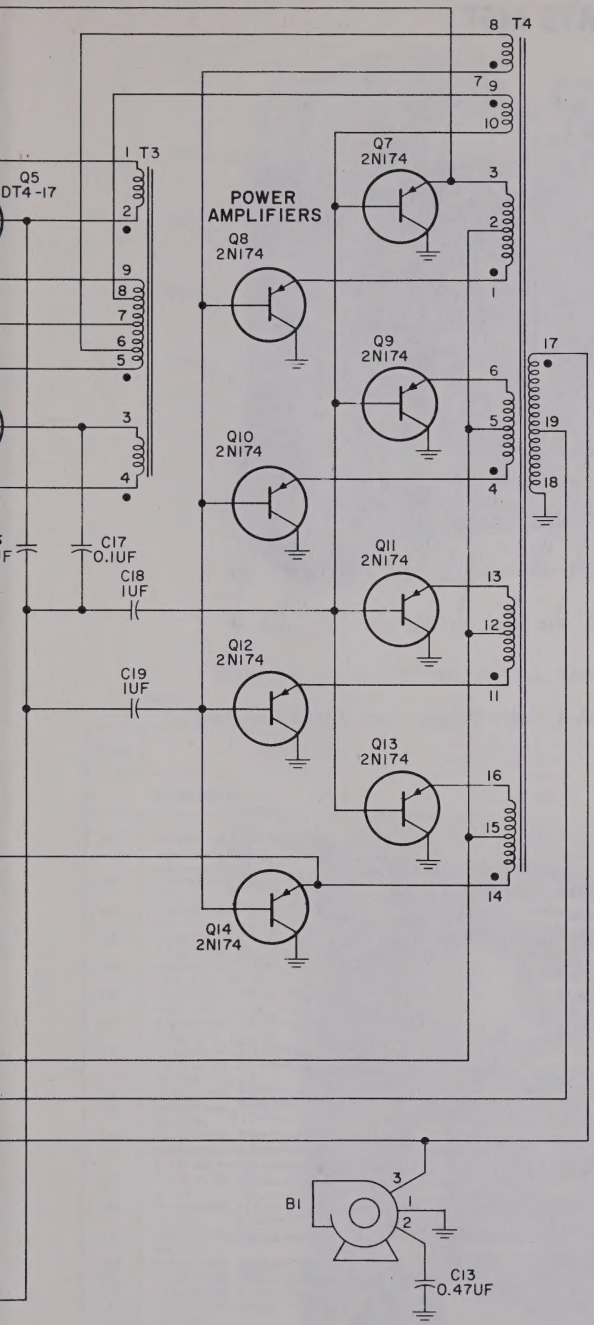

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Figure 3. Collins Inverter 488A-1, Schematic

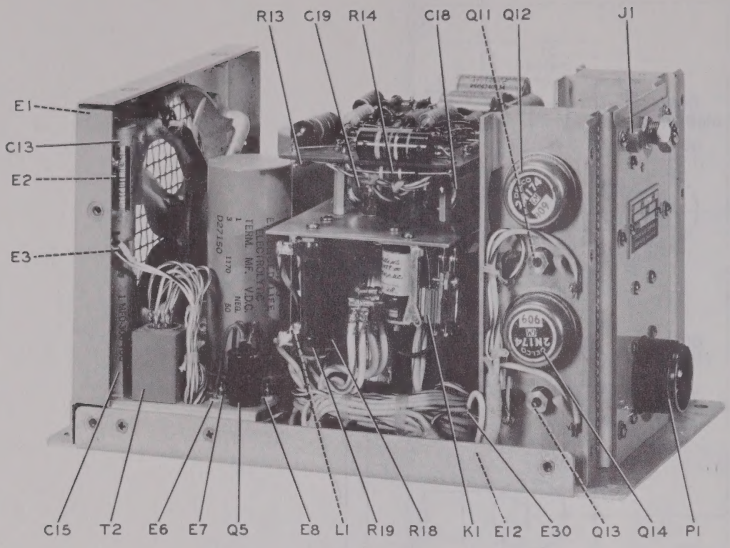

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Figure 4. Collins Inverter 488A-1, Right Oblique View, Cover Removed

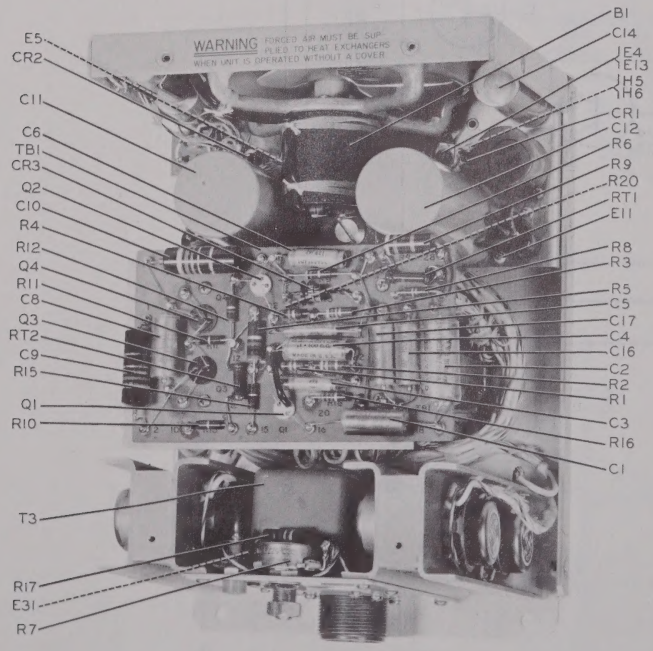

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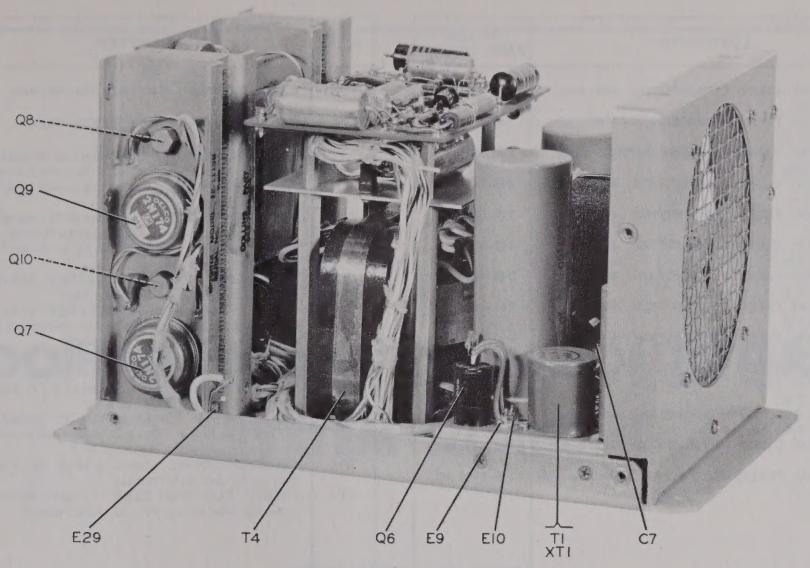
Figure 5. Collins Inverter 488A-1, Top View, Cover Removed



C445-04-P

Figure 6. Collins Inverter 488A-1, Left Oblique View, Cover Removed

ITEM	DESCRIPTION	COLLINS PART NUMBER
	INVERTER 488A-1	522-1193-005
B1	MOTOR, ALTERNATING CURRENT: squirrel cage induction type; 115 v, 400 cps, single phase; 0.13 amp; 4000 rpm	230-0288-00
C1	CAPACITOR, FIXED, PAPER: 0.1 uf, ±20%, 100 v dc	931-4488-00
C2	CAPACITOR, FIXED, PAPER: 0.47 uf, ±20%, 100 v dc	931-2507-00
C3	CAPACITOR, FIXED, DRY ELECTROLYTIC: 4.5 uf, +75% -15%, 50 v dc	184-7037-00
C4	CAPACITOR, FIXED, PAPER: 100,000 uuf, ±20%, 100 v dc	931-2503-00
C5	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, +75% -15%, 25 v dc	184-7030-00
C6	CAPACITOR, FIXED, ELECTROLYTIC: 1 uf, +75%, -15%, 150 v dc	184-7011-00
C7	CAPACITOR, FIXED, DRY ELECTROLYTIC: 175 uf at +25 degrees C and 100 uf at -30 degrees C; -10% +75%, 50 v dc	183-1656-00
C8	CAPACITOR, FIXED, PAPER: same as C1	931-4488-00
C9	CAPACITOR, FIXED, PAPER: 400 v dc; 47,000 uuf, ±10%	931-0295-00
C10	CAPACITOR, FIXED, PAPER: same as C9	931-0295-00
C11	CAPACITOR, FIXED, ELECTROLYTIC: 1170 uf at +25 degrees C, +100% -10%, 50 v dc	183-0014-00
C12	CAPACITOR, FIXED, ELECTROLYTIC: same as C11	183-0014-00
C13	CAPACITOR, FIXED, PAPER: 0.47 uf, ±20%, 300 v dc	931-0538-00
C14	CAPACITOR, FIXED, PAPER: 1 uf, ±20%, 300 v dc	931-1855-00
C15	CAPACITOR, FIXED, PAPER: same as C14	931-1855-00
C16	CAPACITOR, FIXED, PAPER: same as C1	931-4488-00
C17	CAPACITOR, FIXED, PAPER: same as C1	931-4488-00
C18	CAPACITOR, FIXED, PAPER: 1 uf, ±20%, 100 v dc	931-4500-00
C19	CAPACITOR, FIXED, PAPER: same as C18	931-4500-00
CR1	SEMICONDUCTOR DEVICE, DIODE: silicon; type 1N1354RA	353-2621-00
CR2	SEMICONDUCTOR DEVICE, DIODE: silicon; type 1N1359A	353-2622-00
CR3	SEMICONDUCTOR DEVICE, DIODE: silicon; type 1N537	353-1525-00
E1	TERMINAL LUG: 47/64 in. lg, 5/16 in. w, bronze	304-0317-00
E2	TERMINAL, STUD: brass, 1/4 in. hex by 0.632 in. lg overall	306-0234-00
E3	TERMINAL, STUD: same as E2	306-0234-00
E4	TERMINAL, LUG: same as E1	304-0317-00
E5	TERMINAL, STUD: same as E2	306-0234-00
E6	TERMINAL, FEEDTHRU, INSULATED: 0.172 in. dia brass, double type, 0.515 in. lg overall	306-0323-00
E7 thru E11	TERMINAL, FEEDTHRU, INSULATED: same as E6	306-0323-00
E12	TERMINAL LUG: brass 0.040 in. thk, 1 in. w, 7/16 in. h, 0.120 in. dia mtg hole	542-6490-002
E13	TERMINAL LUG: same as E1	304-0317-00
E14 thru E28	NOT USED	
E29 thru E31	TERMINAL LUG: same as E1	304-0317-00
J1	JACK, TIP: accommodates std phone tip, red plastic insulation, precious metal pl contact, terminal lug for wire accommodation	360-0062-00
K1	RELAY ARMATURE: contact arrangement 2B, 5 amps at 28 v dc or 115 v ac	972-1489-00
L1	REACTOR: mechanically adjustable inductance; 0.5 to 5.0 henries inductance; 10 ma dc	678-1205-00
P1	CONNECTOR, RECEPTACLE, ELECTRICAL: 4 contacts, 700 v dc	357-3013-00
Q1	TRANSISTOR: germanium; type 2N414	352-0062-00
Q2	TRANSISTOR: same as Q1	352-0062-00
Q3	TRANSISTOR: germanium; type 2N45	352-0002-00
Q4	TRANSISTOR: same as Q3	352-0002-00
Q5	TRANSISTOR: germanium; PNP internal configuration; type DT4-17	352-0041-00
Q6	TRANSISTOR: same as Q5	352-0041-00
Q7	TRANSISTOR: germanium; 2N174	352-0043-00
Q8 thru Q14	TRANSISTOR: same as Q7	352-0043-00
R1	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%, 1/2 w	745-1394-00
R2	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%, 1/2 w	745-1338-00
R3	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±10%, 1/2 w	745-1422-00
R4	RESISTOR, FIXED, COMPOSITION: same as R1	745-1394-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
R5	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%, 1 w	745-3310-00
R6	RESISTOR, FIXED, COMPOSITION: 4700 ohms, ±10%, 1/2 w	745-1380-00
R7	RESISTOR, VARIABLE, COMPOSITION: 1000 ohms, ±10%, 1 w	380-5279-00
R8	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±5%, 1/2 w	745-1407-00
R9	RESISTOR, FIXED, COMPOSITION: 4700 ohms, ±5%, 2 w	745-5679-00
R10	RESISTOR, FIXED, COMPOSITION: 2200 ohms, ±10%, 1/2 w	745-1366-00
R11	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±10%, 1/2 w	745-1268-00
R12	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±10%, 1/2 w	745-1317-00
R13	RESISTOR, FIXED, COMPOSITION: 4700 ohms, ±10%, 1 w	745-3380-00
R14	RESISTOR, FIXED, COMPOSITION: same as R13	745-3380-00
R15	RESISTOR, FIXED, COMPOSITION: 22 ohms, ±10%, 1/2 w	745-1282-00
R16	RESISTOR, FIXED, COMPOSITION: 680 ohms, ±10%, 1/2 w	745-1345-00
R17	RESISTOR, FIXED, COMPOSITION: 3300 ohms, ±5%, 1 w	745-3365-00
R18	RESISTOR, FIXED, WIRE WOUND: 20 ohms, ±5%, 11 watts	746-6046-00
R19	RESISTOR, FIXED, WIRE WOUND: 40 ohms, ±5%, 11 watts	746-6052-00
R20	RESISTOR, FIXED COMPOSITION: 68,000 ohms ±10%, 1/2 watt	745-1429-00
RT1	RESISTOR, THERMAL: 5000 ohms at 25 degrees C, ±10%; -65 degrees C to +105 degrees C temp range; designed for ac or dc; 1/4 in. dia by 3/4 in. lg; excl. leads	714-1717-00
RT2	RESISTOR, THERMAL: 10 ohms at 25 degrees C, ±10%; -65 degrees C to +105 degrees C temp range; designed for ac or dc; 7/32 in. dia by 5/8 in. lg; excl leads	714-1718-00
T1	TRANSFORMER, AUDIO FREQUENCY: 500 ohms, pri impedance; 2 sec. 500 ohms each	667-0133-00
T2	TRANSFORMER, AUDIO FREQUENCY: plate coupling type; primary 32.5 v, CT; secondary 8 v, CT; 1 ma dc primary and secondary	667-0309-00
T3	TRANSFORMER, AUDIO FREQUENCY: plate coupling type; 1st & 2nd primaries 16.25 v; 400 cps; 1st secondary 16.25 v tapped at 3.7 v; 2nd secondary 16.25 v tapped at 3.7 v	667-0311-00
T4	TRANSFORMER, POWER, STEP-UP: primaries 1, 2, 3, & 4; 32.5 v, CT; primaries 5 and 6, 16.25 v; 400 cps; sec 115 v tapped at 26 v	667-0310-00
TB1	TERMINAL BOARD: plastic, 1/16 in. thk, 3 in. w by 5 in. lg; incl 43 terminals	543-7885-004
XT1	SOCKET, ELECTRON TUBE: 7 contact bottom mounting tube socket with no center shield	220-1277-00

DOPPLER NAVIGATION COMPUTER
SYSTEM NC-103

TEST SET
578L-1

INSTRUCTION BOOK

1 APRIL 1961
1st REVISION, 1 SEPTEMBER 1961
523-0116-00

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1961

CEDAR RAPIDS, IOWA, U.S.A.

PRINTED IN THE UNITED STATES OF AMERICA

RECORD OF REVISIONS

Doppler Navigation Computer System NC-103 Test Set 578L-1	LOCATION
ASSIGNED TO (JOB TITLE)	

REV. NO.	REVISION DATE	INSERTION DATE	BY	REV. NO.	REVISION DATE	INSERTION DATE	BY
1	Sept 1/61	10-21-61	R.T.C.				

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ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

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Figure 1-1. Test Set 578L-1, Over-all View

SECTION I
GENERAL DESCRIPTION

1.1 GENERAL.

This manual provides information on Test Set 578L-1. Topics which are discussed include a general description of the equipment, installation, operation, principles of operation, maintenance, and illustrated parts list. The 578L-1 is shown in figure 1-1.

1.2 FUNCTION.

Test Set 578L-1 will test any doppler navigation computer system which has been designed in accordance to ARINC Characteristic 543. Tbe 578L-1 will test the doppler navigation computer system either on a test bench or installed in the aircraft.

The 578L-1 provides input signals to the doppler navigation computer system which are simulations of those normally obtained from the doppler sensor. If desired, the 578L-1 may be connected as a part of the doppler navigation computer system installation and used as a means of monitoring the operation of the doppler navigation computer system.

1.3 TECHNICAL CHARACTERISTICS.

Power requirements	115 volts ±10 percent, 400 ±20 cps. For accuracy checks on the doppler navigation computer system, 115 ±1 volts, 400 ±1 cps.
Input signals	None required.
Simulated signals:	
Ground speed	500 ±0.25 knots or 0.
Actual track	90 or 0 degrees.
Weight	Approximately 16 pounds.
Dimensions	14 inches long, 8 inches wide, 8 inches high.

1.4 EQUIPMENT SUPPLIED.

Test Set 578L-1, Collins part number 522-2062-00, is supplied complete with a carrying case and power cable.

SECTION II
INSTALLATION

2.1 UNPACKING.

Unpack the equipment with care, and inspect the 578L-1 for possible shipping damage. If a claim for damage is filed with a transportation agency, it is advisable to retain the shipping cartons. Once the equipment has been unpacked and checked for visible shipping damage, it should be subjected to testing. The purpose of this test is to determine the operating condition of the system prior to use and to make any necessary adjustments. The tests are given in paragraph 5.6.

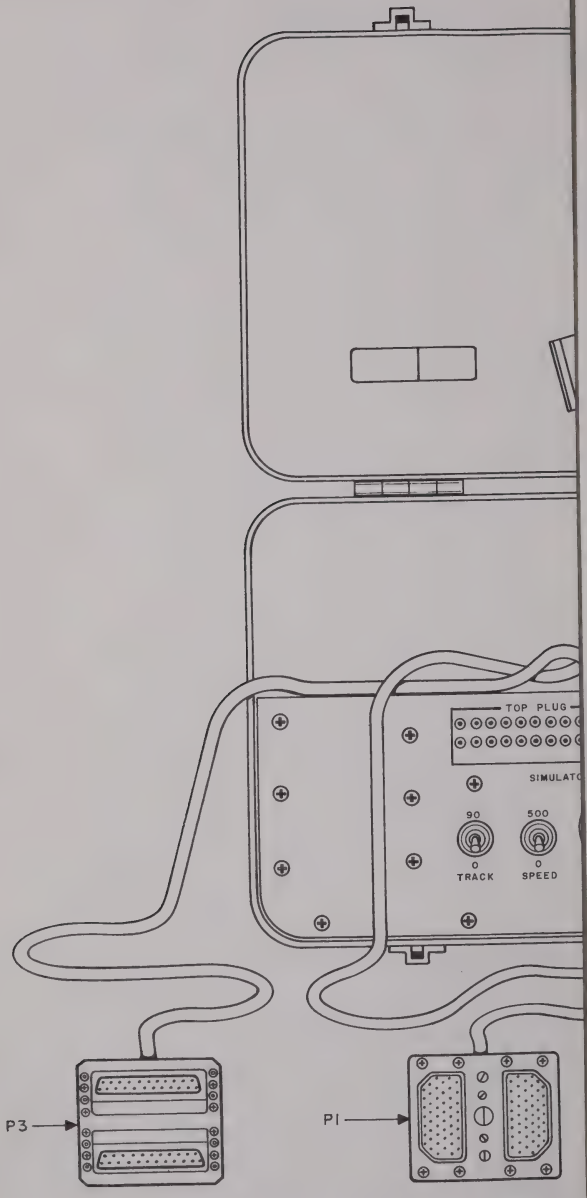


Figure 3-1. Test Set 578L-1 Front Panel, Outline Drawing

SECTION III
OPERATION

3.1 GENERAL.

Test Set 578L-1 is completely controlled locally. Voltage is applied and removed from all circuits in the unit by the POWER ON-OFF switch when the 578L-1 is used for bench tests of the doppler navigation computer system. For tests of the doppler navigation computer system in the aircraft, the 578L-1 obtains power from the aircraft power supply.

3.2 FUNCTION AND LOCATION OF CONTROLS AND CONNECTORS.

Figure 3-1 shows the location of the controls used to operate the 578L-1 and the connectors to provide interconnection between the units of the doppler navigation computer system and the 578L-1. The controls and functions are given in table 3-1.

3.3 TEST SET 578L-1 POWER CABLE.

The power cable, including P1, provides a means of supplying power to the 578L-1 through the front panel connector J1.

3.4 MONITOR TEST JACKS.

The TOP and BOTTOM terminal jacks on the front panel of the 578L-1 provide access to the circuitry of the 578L-1 and the doppler navigation computer system under test for trouble shooting, testing, and adjustment procedures.

3.5 OPERATING PROCEDURES.

Test Set 578L-1 may be used to test the doppler navigation computer system either on the test bench or installed in the aircraft. If desired, the 578L-1 may be installed as a part of the doppler navigation computer system installation and used to monitor the operation of the system through the test jacks on the front panel of the 578L-1.

3.5.1 BENCH OPERATING PROCEDURE.

3.5.1.1 OPERATING CHECKS.

a. Interconnect the computer and control panel of the doppler navigation computer system to the 578L-1 using the connectors P3 and P1 shown in figures 3-1 and 5-2. Apply 115-volt, 400-cps power to J1 of the 578L-1 using power cable. Ground pin C of J1. Set the INPUT SELECTOR switch to SIMULATOR. Set the OFF-ON switch of the control panel to OFF.

b. Set the TRACK switch of the 578L-1 to 0. Set the SPEED switch of the 578L-1 to 500. Set the stage A, TRACK ANGLE display of the control panel to 0. Set the stage A ALONG TRACK display of the control panel to 100. Set the CROSS TRACK display of the control panel to 0. Place the MAN-AUTO switch of the control panel to MAN.

c. Place the OFF-ON switch of the control panel to ON. Press the pushbutton below the stage A indicating flag. The stage A flag should indicate ON, and the stage B flag should indicate OFF. The CROSS TRACK display should remain at 0, and the stage A ALONG TRACK display should begin a countdown toward 0 from the initial setting of 100.

d. Before the stage A ALONG TRACK display reaches 0, switch the MAN-AUTO switch of the control panel

TABLE 3-1
578L-1 OPERATING CONTROLS

CONTROL	FUNCTION
TRACK	A two-position toggle switch to provide data simulation for 0- and 90-degree ground-track angles.
SPEED	A two-position toggle switch to provide data simulation for ground speeds of 0 and 500 knots.
INPUT SELECTOR	A two-position wafer switch which determines whether doppler data will be furnished from a doppler sensor or from the 578L-1.
STRUT OVER RIDE INTERLOCK	Shorts the contacts (in the up position) of the strut switch relay of the aircraft when the doppler navigation computer system is installed in an aircraft while on the ground, or simulates the strut switch relay when the system is being tested on the bench.
POWER ON-OFF	A two-position toggle switch which applies or removes operating voltage for the 578L-1 for bench tests.

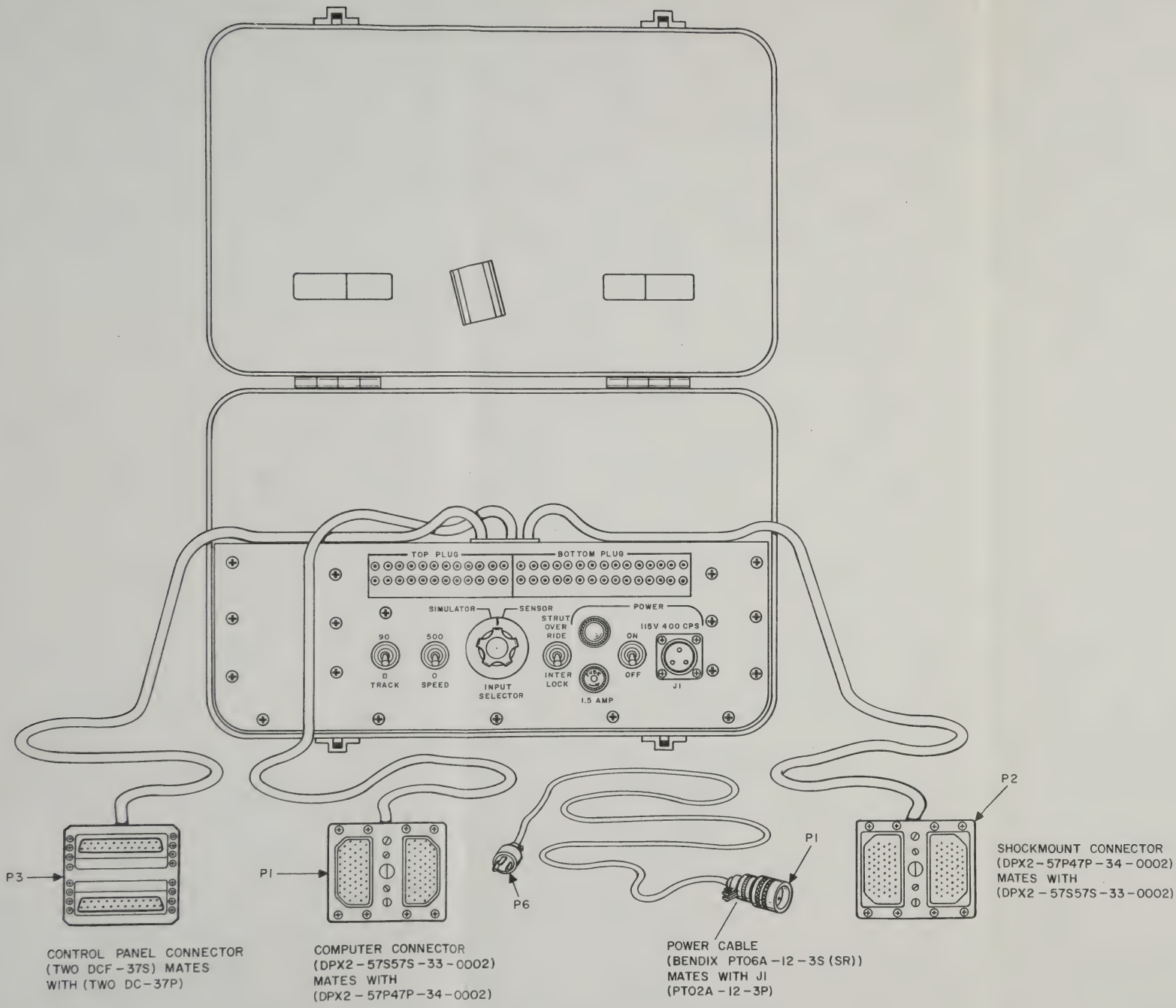


Figure 3-1. Test Set 578L-1 Front Panel, Outline Drawing

SECTION III
OPERATION

3.1 GENERAL.

Test Set 578L-1 is completely controlled locally. Voltage is applied and removed from all circuits in the unit by the POWER ON-OFF switch when the 578L-1 is used for bench tests of the doppler navigation computer system. For tests of the doppler navigation computer system in the aircraft, the 578L-1 obtains power from the aircraft power supply.

3.2 FUNCTION AND LOCATION OF CONTROLS AND CONNECTORS.

Figure 3-1 shows the location of the controls used to operate the 578L-1 and the connectors to provide interconnection between the units of the doppler navigation computer system and the 578L-1. The controls and functions are given in table 3-1.

3.3 TEST SET 578L-1 POWER CABLE.

The power cable, including P1, provides a means of supplying power to the 578L-1 through the front panel connector J1.

3.4 MONITOR TEST JACKS.

The TOP and BOTTOM terminal jacks on the front panel of the 578L-1 provide access to the circuitry of the 578L-1 and the doppler navigation computer system under test for trouble shooting, testing, and adjustment procedures.

3.5 OPERATING PROCEDURES.

Test Set 578L-1 may be used to test the doppler navigation computer system either on the test bench or installed in the aircraft. If desired, the 578L-1 may be installed as a part of the doppler navigation computer system installation and used to monitor the operation of the system through the test jacks on the front panel of the 578L-1.

3.5.1 BENCH OPERATING PROCEDURE.

3.5.1.1 OPERATING CHECKS.

a. Interconnect the computer and control panel of the doppler navigation computer system to the 578L-1 using the connectors P3 and P1 shown in figures 3-1 and 5-2. Apply 115-volt, 400-cps power to J1 of the 578L-1 using power cable. Ground pin C of J1. Set the INPUT SELECTOR switch to SIMULATOR. Set the OFF-ON switch of the control panel to OFF.

b. Set the TRACK switch of the 578L-1 to 0. Set the SPEED switch of the 578L-1 to 500. Set the stage A, TRACK ANGLE display of the control panel to 0. Set the stage A ALONG TRACK display of the control panel to 100. Set the CROSS TRACK display of the control panel to 0. Place the MAN-AUTO switch of the control panel to MAN.

c. Place the OFF-ON switch of the control panel to ON. Press the pushbutton below the stage A indicating flag. The stage A flag should indicate ON, and the stage B flag should indicate OFF. The CROSS TRACK display should remain at 0, and the stage A ALONG TRACK display should begin a countdown toward 0 from the initial setting of 100.

d. Before the stage A ALONG TRACK display reaches 0, switch the MAN-AUTO switch of the control panel

TABLE 3-1
578L-1 OPERATING CONTROLS

CONTROL	FUNCTION
TRACK	A two-position toggle switch to provide data simulation for 0- and 90-degree ground-track angles.
SPEED	A two-position toggle switch to provide data simulation for ground speeds of 0 and 500 knots.
INPUT SELECTOR	A two-position wafer switch which determines whether doppler data will be furnished from a doppler sensor or from the 578L-1.
STRUT OVER RIDE INTERLOCK	Shorts the contacts (in the up position) of the strut switch relay of the aircraft when the doppler navigation computer system is installed in an aircraft while on the ground, or simulates the strut switch relay when the system is being tested on the bench.
POWER ON-OFF	A two-position toggle switch which applies or removes operating voltage for the 578L-1 for bench tests.

to AUTO, set the TRACK ANGLE display of stage B to 0, and set the ALONG TRACK display of stage B to 100. As the ALONG TRACK display of stage A reaches 0, check that transfer from stage A to stage B of the control panel is achieved automatically. Check that the stage B indicator now reads ON, and the stage A flag reads OFF. Check that the ALONG TRACK display of stage B begins a countdown from the initial setting of 100 and that the CROSS TRACK display remains at 0.

e. Before the ALONG TRACK display of stage B reaches 0, set in an ALONG TRACK display on stage A of the control panel. Check that transfer is obtained automatically from stage B to stage A when the ALONG TRACK display of stage B reaches 0. The stage A flag should indicate ON, the stage B flag should indicate OFF, and the ALONG TRACK display of stage A should begin a countdown from the initial setting.

f. Set the TRACK ANGLE of stage A of the control panel to 0. Set the TRACK switch of the 578L-1 to 90. Activate stage A, and check that the ALONG TRACK display does not change. Check that the CROSS TRACK reading changes in order of increasing numbers and that a RIGHT indication is obtained.

g. Set up a TRACK ANGLE of 90 degrees on stage B of the control panel. Set the TRACK switch of the 578L-1 to 0. Activate stage B by pressing the button under the stage-indicating flag. The CROSS TRACK display should go to 0 and then change in order of increasing numbers with a LEFT indication.

h. Set up a TRACK ANGLE of 45 degrees on the TRACK ANGLE display of each stage of the control panel. Set the TRACK switch of the 578L-1 to 90 degrees. Alternately activate each stage of the control panel, and check that the ALONG TRACK and CROSS TRACK displays change readings at the same rate. The CROSS TRACK display should change in order of increasing numbers and read RIGHT. The ALONG TRACK display should count down from the initial setting.

3.5.1.2 CALIBRATION.

The following steps should be performed to determine if the doppler navigation computer system is calibrated properly and to perform whatever adjustments might be required:

Interconnect the doppler navigation computer system to the Test Set 578L-1, and perform the operating checks described in paragraph 3.5.1.1.

Calibration procedures should not be attempted until the equipment has been allowed to warm up. Check that the 115-volt, 400-cps power supplied to the 578L-1 is 115 ±1 volts and 400 ±2 cps.

3.5.1.2.1 DRIFT CHECKS.

a. Set the TRACK switch of the 578L-1 to 0. Set the SPEED switch of the 578L-1 to 0. Set the TRACK ANGLE display of both stage A and stage B to 0. Set the OFF-ON switch of the control panel to ON. Set the MAN-AUTO switch of the control panel to MAN. Activate either stage of the control panel.

b. Note the reading of the ALONG TRACK display of the active stage, and allow power to be applied to the system for a minimum of one hour. Note any changes in the reading of the ALONG TRACK display of the active stage. The reading should not change by more than the computer system specifications in one hour. Activate the other stage of the control panel and repeat for this stage; the response should be the same.

c. If the variation in one hour is more than that specified, make the necessary adjustments of the computer.

d. Set the TRACK switch to 0 and the SPEED switch to 500. Set the TRACK ANGLE display of both stages of the control panel to 0. Activate either stage of the control panel and check for variations in the reading of the CROSS TRACK display. In one hour the indication of the CROSS TRACK display should not change by more than that specified.

e. If the variations in the CROSS TRACK display are more than that specified, make the necessary adjustment.

3.5.1.2.2 SCALE FACTOR CHECKS.

a. Set the TRACK switch of the 578L-1 to 0. Set the SPEED switch of the 578L-1 to 500. Set the TRACK ANGLE display of both stages of the control panel to 0.

b. Take an initial reading of the active stage ALONG TRACK display. After exactly one hour running time, as measured with a stop watch, the ALONG TRACK display should indicate a distance elapsed of 500 ±4 miles.

c. If the response is not correct, make the necessary adjustment until the desired response is obtained.

d. Set the TRACK switch of the 578L-1 to 90. Set the SPEED switch of the 578L-1 to 500. Set the TRACK ANGLE display of the active stage to 0. Set CROSS TRACK display to 10 LEFT.

e. Record the CROSS TRACK display, and start to time the system for 12 minutes. After exactly 12 minutes running time, as measured with a stop watch, record the reading of the CROSS TRACK display. The display should indicate a total elapsed distance of 100 ±2 miles. (CROSS TRACK reading 90 RIGHT)

f. If the response is not correct, make the necessary adjustment.

3.5.2 OPERATING PROCEDURES IN THE AIRCRAFT.

NOTE

Power for the 578L-1 will be obtained from the aircraft supply. Power connector J1 of the 578L-1 will be disconnected from any external supply, S5 will be off, and K1 de-energized.

a. Remove the computer from the shockmount. Connect the mounting connector of Test Set 578L-1 to the

connector of the shockmount (P2, figure 3-1). Connect the computer to the computer connector of the 578L-1 (P3, figure 3-1).

b. Apply aircraft power to the doppler navigation computer system. Apply aircraft power to the doppler sensor system. Set the INPUT SELECTOR switch of the 578L-1 to SENSOR. Set the OFF-ON switch of the control panel to ON. Using the ground-speed and drift-angle slewing switches of the control unit of the doppler sensor unit, slew the drift angle to 0 and the ground speed to 500 knots. Check that the ALONG TRACK display of the control panel begins a countdown and functions properly.

c. Slew the drift angle to 20 degrees RIGHT. Check that the CROSS TRACK display functions properly.

d. Set the OFF-ON switch of the control panel to OFF. Check that aircraft power is applied to the doppler navigation computer system. Set the INPUT SELECTOR switch of the 578L-1 to SIMULATOR.

e. Turn ON the OFF-ON switch of the control panel. Using a voltohmmeter, check the system power supply voltages at the jacks listed in table 3-2. The voltages measured should conform to the values given in table 3-2. Turn OFF the OFF-ON switch.

f. Set the TRACK switch of the 578L-1 to the 0 position. Set the SPEED switch of the 578L-1 to the 500 position. Set the stage A, TRACK ANGLE display of the control panel to 0. Set the stage A ALONG TRACK display of the control panel to 100. Set the CROSS TRACK display of the control panel to 0. Place the MAN-AUTO switch of the control panel to MAN.

g. Place the OFF-ON switch of the control panel to ON. Press the pushbutton below the stage A indicating flag. The stage A flag should indicate ON, and the stage B flag should indicate OFF. The CROSS TRACK display should remain at 0, and the stage A ALONG TRACK display should begin a countdown toward 0 from the initial setting of 100.

h. Before the stage A ALONG TRACK display reaches 0, switch the MAN-AUTO switch of the control panel to AUTO, set the TRACK ANGLE display of stage B to 0, and set the ALONG TRACK display of stage B to 100. As the ALONG TRACK display of stage A reaches 0, check that transfer from stage A to stage B of the control panel is achieved automatically. Check that the stage B flag indicator now reads ON and the stage A flag reads OFF. Check that the ALONG TRACK display of stage B begins a countdown from the initial setting of 100 and that the CROSS TRACK display remains at 0.

i. Before the ALONG TRACK display of stage B reaches 0, set in an ALONG TRACK display on stage A of the control panel. Check that transfer is obtained automatically from stage B to stage A when the ALONG TRACK display of stage B reaches 0. The stage A flag should indicate ON, the stage B flag should indicate OFF, and the ALONG TRACK display of stage A should begin a countdown from the initial setting.

j. Set the TRACK ANGLE of stage A of the control panel to 0. Set the TRACK switch of the 578L-1 to 90. Activate stage A, and check that the ALONG TRACK display does not change. Check that the CROSS TRACK reading changes in order of increasing numbers and that a RIGHT indication is obtained.

TABLE 3-2
POWER SPECIFICATIONS

JACK NUMBER OF THE 578L-1	POWER REQUIREMENTS (VOLTAGES MEASURED)
BOTTOM PLUG terminal 51	26 (±3) volts, 400 (±20) cps
BOTTOM PLUG terminal 54	115 (±12) volts, 400 (±20) cps
*BOTTOM PLUG terminal 53	26 (±3) volts, 400 (±20) cps
BOTTOM PLUG terminal 48	Ground

*26 volts, 400 cps will be present at BOTTOM PLUG terminal 53 only if this power is obtained from the automatic flight control system and supplied to BP-53 of the computer.

k. Set up a TRACK ANGLE of 90 degrees on stage B of the control panel. Set the TRACK switch of the 578L-1 to 0. Activate stage B by pressing the button under the stage-indicating flag. The CROSS TRACK display should go to 0 and then change in order of increasing numbers with a LEFT indication.

l. Set up a TRACK ANGLE of 45 degrees on the TRACK ANGLE display of each stage of the control panel. Set the TRACK switch of the 578L-1 to 90 degrees. Alternately activate each stage of the control panel, and check that the ALONG TRACK and CROSS TRACK displays change readings at the same rate. The CROSS TRACK display should change in order of increasing numbers and read RIGHT. The ALONG TRACK display should count down from the initial setting.

m. Set the TRACK switch of the 578L-1 to 0. Set the SPEED switch of the 578L-1 to 0. Set the TRACK ANGLE display of both stage A and stage B to 0. Set the OFF-ON switch of the control panel to ON. Set the MAN-AUTO switch of the control panel to MAN. Activate either stage of the control panel.

n. Note the reading of the ALONG TRACK display of the active stage. Note any changes in the reading of the ALONG TRACK display of the active stage. The reading should not change by more than that specified for the system in one hour. Activate the other stage of the control panel and repeat for this stage; the response should be the same.

o. Set the TRACK switch to 0 and the SPEED switch to 500. Set the TRACK ANGLE display of both stages of the control panel to 0. Activate either stage of the control panel, and check for variations in the reading of the CROSS TRACK display. In one hour, the indication of the CROSS TRACK display should not change by more than that specified.

p. Set the TRACK switch of the 578L-1 to 0. Set the SPEED switch of the 578L-1 to 500. Set the TRACK ANGLE display of both stages of the control panel.

q. Take an initial reading of the active stage ALONG TRACK display. After exactly one hour running time, as measured with a stop watch, the ALONG TRACK display should indicate a distance elapsed of 500 ±4 miles.

r. Set the TRACK switch of the 578L-1 to 90. Set the SPEED switch of the doppler radar simulator to 500. Set the TRACK ANGLE display of the active stage to 0. Set CROSS TRACK display to 10 LEFT.

s. Record the CROSS TRACK display, and time the system for 12 minutes. After exactly 12 minutes running time, as measured with a stop watch, record the reading of the CROSS TRACK display. The display should indicate a total elapsed distance of 100 ±2 miles (CROSS TRACK reading 90 RIGHT).

3.5.3 IN-FLIGHT MONITORING.

Test Set 578L-1 can be used as a part of the doppler navigation computer system to monitor the operation of the computer while the aircraft is in flight. To obtain this setup, the computer is removed from the shockmount, connector J1 (figure 3-1) of the 578L-1 is plugged in the computer, connector J2 (figure 3-1) is plugged in the shockmount, and the INPUT SELECTOR switch is set to SENSOR. The terminals on the TOP and BOTTOM plugs on the front panel are used to accomplish the monitoring.

SECTION IV
PRINCIPLES OF OPERATION

4.1 INTRODUCTION.

Test Set 578L-1 is an interconnecting harness to be used in testing the doppler navigation computer system on the test bench or during preflight testing of the doppler navigation computer system in the aircraft. The 578L-1 provides sensor information for, or a means of connecting doppler sensor information to, the computer system.

4.2 VOLTAGE CIRCUIT.

For bench testing, power is provided to connector J1 (paragraph 3.3). The input voltage, 115 volts 400 cps, is applied to transformer T1 through ON-OFF switch S5 and fuse F1. The 115 volts 400 cps and 26 volts 400 cps, developed in the secondary winding of transformer T1, are applied to the arms of relay K1. Input voltage is rectified by CR1, and a portion of this voltage is applied to relay K1. The relay energizes and applies the 26- and 115-volt 400-cps voltages to units of the doppler navigation computer system. The relay separates the 578L-1 power supply from the aircraft power supply when the 578L-1 is used in the aircraft and receives its power from the aircraft power supply. The 115 volts 400 cps is applied to lamp DS1 through resistor R12 to indicate that the power is on and applied to the computer system units when the 578L-1 is used on the bench or in the aircraft.

4.3 TRACK SIMULATORS.

The track simulators, B1 and B2, are synchro transmitters. The rotor of B1 is set to 0 degree and the rotor of B2 is set to 90 degrees from an electrical zero. The synchro output, from the X, Y, and Z windings of either transmitter B1 or B2, is coupled through the INPUT SELECTOR switch to the doppler navigation computer system when the INPUT SELECTOR switch is in the SIMULATOR position. TRACK switch S2 selects the output of rotor B1 when in the 0 position, and the output of rotor B2 when in the 90 position.

4.4 SPEED SIMULATORS.

Two speed simulators are used in the 578L-1 circuitry to provide simulation of 0 or 500 knots for along track and cross track speeds. A fixed voltage divider of R5, R6, R7, R8, and R10 provides a fixed voltage for along track speed when SPEED switch S2 is in the 500 position. Also, when S2 is in the 500 position, a fixed voltage is provided for the cross track speed by the divider network of R1, R2, R3, R4, and R9. When S2 is in the 0 position, a short circuit is placed across the voltage dividers. The outputs of the speed simulators are coupled through the INPUT SELECTOR switch to the doppler navigation computer system when the INPUT SELECTOR switch is in the SIMULATOR position.

4.5 SIMULATOR-SENSOR SELECTOR.

The INPUT SELECTOR, switch S3, picks either the output from a doppler sensor or the doppler radar simulators (speed and track) of the 578L-1 to be coupled to the doppler navigation computer system.

4.6 STRUT OVER RIDE INTERLOCK.

The STRUT OVER RIDE INTERLOCK switch, when closed, shorts out the contacts of the strut switch relay of the aircraft, or simulates the closed strut switch relay when used for bench testing.

SECTION V
MAINTENANCE

5.1 INTRODUCTION.

This section contains maintenance instructions for Test Set 578L-1. Before attempting to service the 578L-1, maintenance personnel should be thoroughly familiar with the equipment layout and principles of operation.

5.2 PERIODIC CHECKS.

If the 578L-1 is used frequently (2 to 3 times a week), it should be calibrated every 3 months. Refer to paragraph 5.5.

5.3 TEST EQUIPMENT REQUIRED.

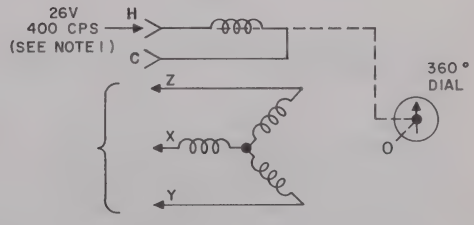
The test equipment required to repair, calibrate, and test the 578L-1 is given in table 5-1.

TABLE 5-1. TEST EQUIPMENT REQUIRED

EQUIPMENT	MANUFACTURER AND TYPE	PARAGRAPH REFERENCE
Voltmeter	Ballantine Model 300	
Voltohmmeter	Triplett Model 630	
Control Transformer	Collins P/N 229-0113-00	5.3.1, 5.5.3
Readout Dial	Collins P/N 545-3917-004	5.3.1, 5.5.3
Dekavider	Electro-Scientific Industries DV-411	5.5.1, 5.5.2
Doppler Navigation Computer System Control Panel and Computer (designed in accordance with ARINC Characteristics 543)		
Stop Watch		5.6.3, 5.6.4

5.3.1 CONTROL TRANSFORMER TEST JIG.

The control transformer test jig consists of the control transformer and readout dial listed in table 5-1. Refer to figure 5-1 to calibrate the synchro. Excite the rotor (pins H and C) with 26 volts, 400 cps. Connect an a-c voltmeter from X to H. Short X to Y and Z to C. With readout dial set at 0, rotate the case to obtain a maximum reading on the voltmeter. Remove the shorts between X and Y, and Z and C. Connect a-c voltmeter between X and Y, and rotate case for a null on voltmeter. This adjusts the synchro for a 0-degree index reference.



1 THE 26 VOLTS SHOULD BE OF THE SAME PHASE AS THE 115-VOLT 400-CPS SUPPLIED TO THE POWER-PANEL OF THE INTERCONNECTING HARNESS.

2 X, Y, Z ARE IN ACCORDANCE WITH ARINC STANDARDS.

Figure 5-1. Control Transformer Test Jig

5.4 CORRECTIVE MAINTENANCE.

5.4.1 TEST SETUP.

Connect the Test Set 578L-1 to the doppler navigation computer system units with the pendant cables, and

plug the power cord in a 115-volt 400-cps supply. Use the test equipment listed in table 5-1 as required to locate fault in the test set.

5.4.2 TROUBLE SHOOTING.

Most troubles in Test Set 578L-1 can be localized quickly by indications given on the control panel of the doppler navigation computer system. Once the faulty circuit has been identified, circuit tracing with an ohmmeter will usually locate the fault. Table 5-2 lists symptoms, probable causes and remedies for trouble which may occur. For hard to find troubles, such as those giving multiple symptoms, refer to the schematic diagram, figure 7-1, and circuit trace all circuits believed to be faulty. When a blown fuse is found, check to determine the cause. Refer to figures 5-2 and 5-3 to locate components.

TABLE 5-2. TROUBLE-SHOOTING CHART FOR TEST SET 578L-1

SYMPTOM	PROBABLE CAUSE	REMEDY
Lamp will not light when switch is turned ON with the 578L-1 on the bench. (In the aircraft, the 115 volts is applied to the lamp from the aircraft power supply.)	Fuse F1 blown, defective bulb, crystal CR1, resistor R11, relay K1, resistor R12, transformer T1.	Replace fuse and/or bulb. Circuit trace to localize trouble and correct faulty component or wiring.
No voltage at J51 on bottom plug.	Relay K1 contacts 2 and 12.	Replace relay K1.
No voltage at J53 on bottom plug.	Relay K1 contacts 4 and 11.	Replace relay K1.
Dials on control panel unstable when the SPEED simulator switch is set at 0.	Speed simulator switch S2 circuitry.	Make resistance and continuity checks to locate fault.
Dials on control unit do not rotate when SPEED simulator switch is set at 500.	Speed simulator switch S2 circuitry.	Make resistance and continuity checks to locate fault.

5.5 ADJUSTMENT PROCEDURES.

5.5.1 ALONG TRACK SPEED SIMULATOR ADJUSTMENT.

NOTE

All connections on the 578L-1 are made on the front panel terminals.

a. Set SPEED switch to 500.
b. Set INPUT SELECTOR to SIMULATOR.
c. Connect the dekavider terminals as follows:
Output to terminal 28 of BOTTOM PLUG.
Input to terminal 27 of BOTTOM PLUG.
Common to terminal 26 of BOTTOM PLUG.
d. Set dekavider reading to .05578 as follows: (figure 5-1)
Set left outer dial to 0.
Set left inner dial to 5.
Set right outer dial to 5.
Set right inner dial to 78.
e. Apply 26 volts 400 cps through a 400-cps isolation transformer across the dekavider.
f. Adjust R10 of the 578L-1 for a null on the voltmeter.

5.5.2 CROSS TRACK SPEED SIMULATOR ADJUSTMENT.

a. Set SPEED switch to 500.
b. Set INPUT SELECTOR to SIMULATOR.
c. Connect dekavider terminals as follows:
Output to terminal 19 of TOP PLUG.
Input to 18 of TOP PLUG.
Common to terminal 20 of TOP PLUG.
d. Perform steps d and e in paragraph 5.5.1.
e. Adjust R9 of the 578L-1 for a null on voltmeter.

5.5.3 SYNCHRO INDEX ADJUSTMENT.

a. Set INPUT SELECTOR to SIMULATOR.
b. Connect 26 volts 400 cps to terminal 16 of TOP PLUG and terminal 50 of BOTTOM PLUG.
c. Place a jumper between terminals 16 and 50 of BOTTOM PLUG.
d. Place a jumper between terminals 14 and 15 of the BOTTOM PLUG.

SECTION V
MAINTENANCE

5.1 INTRODUCTION.

This section contains maintenance instructions for Test Set 578L-1. Before attempting to service the 578L-1, maintenance personnel should be thoroughly familiar with the equipment layout and principles of operation.

5.2 PERIODIC CHECKS.

If the 578L-1 is used frequently (2 to 3 times a week), it should be calibrated every 3 months. Refer to paragraph 5.5.

5.3 TEST EQUIPMENT REQUIRED.

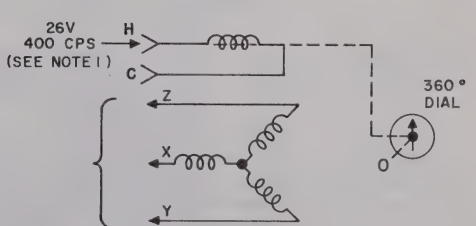
The test equipment required to repair, calibrate, and test the 578L-1 is given in table 5-1.

TABLE 5-1. TEST EQUIPMENT REQUIRED

EQUIPMENT	MANUFACTURER AND TYPE	PARAGRAPH REFERENCE
Voltmeter	Ballantine Model 300	
Voltohmmeter	Triplett Model 630	
Control Transformer	Collins P/N 229-0113-00	5.3.1, 5.5.3
Readout Dial	Collins P/N 545-3917-004	5.3.1, 5.5.3
Dekavider	Electro-Scientific Industries DV-411	5.5.1, 5.5.2
Doppler Navigation Computer System Control Panel and Computer (designed in accordance with ARINC Characteristics 543)		
Stop Watch		5.6.3, 5.6.4

.3.1 CONTROL TRANSFORMER TEST JIG.

The control transformer test jig consists of the control transformer and readout dial listed in table 5-1. Refer to figure 5-1 to calibrate the synchro. Excite the rotor (pins H and C) with 26 volts, 400 cps. Connect an a-c voltmeter from X to H. Short X to Y, and Z to C. With readout dial set at 0, rotate the case to obtain a maximum reading on the voltmeter. Remove the shorts between X and Y, and Z and C. Connect a-c voltmeter between X and Y, and rotate case for a null on voltmeter. This adjusts the synchro for a 0-degree index reference.



1 THE 26 VOLTS SHOULD BE OF THE SAME PHASE AS THE 115-VOLT 400-CPS SUPPLIED TO THE POWER-PANEL OF THE INTERCONNECTING HARNESS.

2 X, Y, Z ARE IN ACCORDANCE WITH ARINC STANDARDS.

Figure 5-1. Control Transformer Test Jig

.4 CORRECTIVE MAINTENANCE.

.4.1 TEST SETUP.

Connect the Test Set 578L-1 to the doppler navigation computer system units with the pendant cables, and

plug the power cord in a 115-volt 400-cps supply. Use the test equipment listed in table 5-1 as required to locate fault in the test set.

5.4.2 TROUBLE SHOOTING.

Most troubles in Test Set 578L-1 can be localized quickly by indications given on the control panel of the doppler navigation computer system. Once the faulty circuit has been identified, circuit tracing with an ohmmeter will usually locate the fault. Table 5-2 lists symptoms, probable causes and remedies for trouble which may occur. For hard to find troubles, such as those giving multiple symptoms, refer to the schematic diagram, figure 7-1, and circuit trace all circuits believed to be faulty. When a blown fuse is found, check to determine the cause. Refer to figures 5-2 and 5-3 to locate components.

TABLE 5-2. TROUBLE-SHOOTING CHART FOR TEST SET 578L-1

SYMPTOM	PROBABLE CAUSE	REMEDY
Lamp will not light when switch is turned ON with the 578L-1 on the bench. (In the aircraft, the 115 volts is applied to the lamp from the aircraft power supply.)	Fuse F1 blown, defective bulb, crystal CR1, resistor R11, relay K1, resistor R12, transformer T1.	Replace fuse and/or bulb. Circuit trace to localize trouble and correct faulty component or wiring.
No voltage at J51 on bottom plug.	Relay K1 contacts 2 and 12.	Replace relay K1.
No voltage at J53 on bottom plug.	Relay K1 contacts 4 and 11.	Replace relay K1.
Dials on control panel unstable when the SPEED simulator switch is set at 0.	Speed simulator switch S2 circuitry.	Make resistance and continuity checks to locate fault.
Dials on control unit do not rotate when SPEED simulator switch is set at 500.	Speed simulator switch S2 circuitry.	Make resistance and continuity checks to locate fault.

5.5 ADJUSTMENT PROCEDURES.

5.5.1 ALONG TRACK SPEED SIMULATOR ADJUSTMENT.

NOTE

All connections on the 578L-1 are made on the front panel terminals.

a. Set SPEED switch to 500.
b. Set INPUT SELECTOR to SIMULATOR.
c. Connect the dekavider terminals as follows:
An a-c vtvm between the dekavider output and terminal 28 of BOTTOM PLUG.
Input to terminal 27 of BOTTOM PLUG.
Common to terminal 26 of BOTTOM PLUG.
d. Set dekavider reading to .50847 as follows: (figure 5-4)
e. Apply 26 volts 400 cps through a 400-cps isolation transformer across the dekavider.
f. Adjust R10 of the 578L-1 for a null on the voltmeter.

5.5.2 CROSS TRACK SPEED SIMULATOR ADJUSTMENT

a. Set SPEED switch to 500.
b. Set INPUT SELECTOR to SIMULATOR.
c. Connect dekavider terminals as follows:
An a-c vtvm between the dekavider output and terminal 19 of TOP PLUG.
Input to terminal 18 of TOP PLUG.
Common to terminal 20 of TOP PLUG.
d. Perform steps d and e in paragraph 5.5.1.
e. Adjust R9 of the 578L-1 for a null on voltmeter.

5.5.3 SYNCHRO INDEX ADJUSTMENT.

a. Set INPUT SELECTOR to SIMULATOR.
b. Connect 26 volts 400 cps to terminal 16 of TOP PLUG and terminal 50 of BOTTOM PLUG.
c. Place a jumper between terminals 16 and 50 of BOTTOM PLUG.
d. Place a jumper between terminals 14 and 15 of the BOTTOM PLUG.

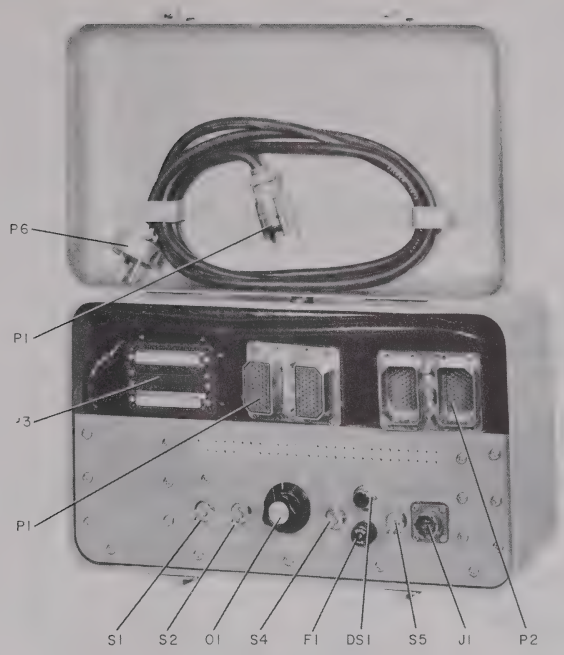


Figure 5-2. Test Set 578L-1, Over-all View

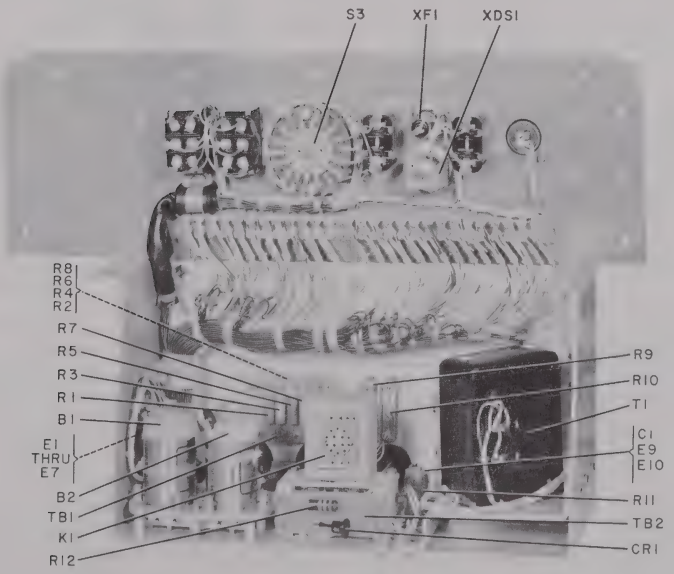


Figure 5-3. Test Set 578L-1, Chassis with Case Removed and Front Panel Folded Back

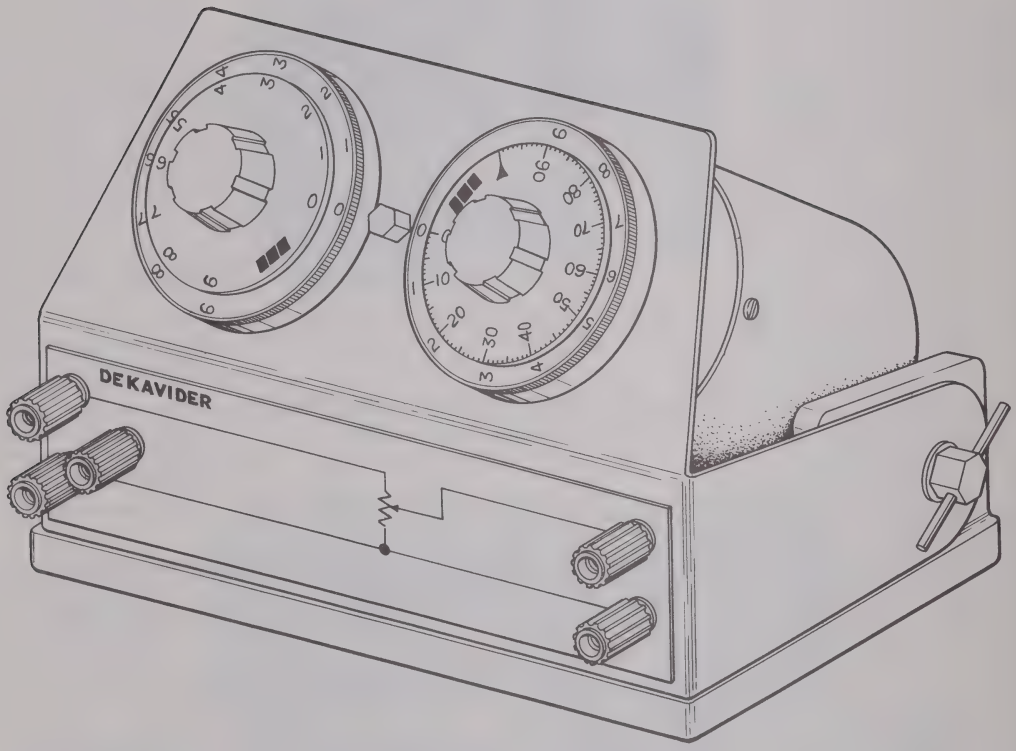


Figure 5-4. Dekavider DV-411

e. Connect an a-c voltmeter to terminals 14 of OTTOM PLUG and 16 of TOP PLUG.
f. Set TRACK switch to 0.
g. Loosen clamp holding rotor, at the bottom of B1, id rotate rotor to obtain a minimum reading (approxiately 16 volts). Tighten clamp.
h. Set TRACK switch to 90.
i. Loosen clamp holding rotor at the bottom of B2, id rotate rotor to obtain a minimum reading (approxiately 16 volts). Tighten clamp.
j. Remove jumpers between terminals 16 and 50 of OTTOM PLUG and terminals 14 and 15 of BOTTOM LUG.
k. Remove lead of voltmeter from terminal 16 of OP PLUG and connect to terminal 15 of BOTTOM LUG.
l. Set TRACK switch to 0.
m. Loosen clamp on rotor of B1, and adjust for a null the voltmeter. Tighten clamp.
n. Set TRACK switch to 90.
o. Loosen clamp on rotor of B2, and adjust for a null the voltmeter. Tighten clamp.
p. Connect the stator of the test control transformer, adjusted for the 0-degree index reference in paraaph 5.3.1, to stator of synchro B2.
q. Adjust rotor of the test control transformer to 90 egrees as indicated on dial.
r. Loosen clamp of synchro B2 rotor, and turn rotor degrees in a positive rotation reference from the degree index (indicated by voltmeter null reading).

NOTE

To determine the positive rotation reference, connect an a-c voltmeter across terminals 14 and 16 of BOTTOM PLUG (X and Z of synchro B2), set INPUT SELECTOR to simulator, and turn rotor slightly. If it is turned in the positive rotation reference direction, the voltage will increase from 10.5 to 12 volts. The rotation from the index reference position must not exceed 30 degrees when determining the rotation reference.

6 OPERATIONAL TESTS.

6.1 TEST REQUIREMENTS.

a. Connect the computer and control panel of the ppler navigation computer system to P1 and P3 of the 578L-1 (figure 3-1). Connect the 115-volt, 400-cps power cord to J1 of the 578L-1.
b. Set INPUT SELECTOR switch to SIMULATOR.
c. Set strut switch to STRUT OVER RIDE.
d. Turn POWER switches of control panel and 578L-1 to ON.

5.6.2 DRIFT TEST.

Set the SPEED simulator switch to 0. None of the dials on the control panel should move.

5.6.3 ALONG TRACK SPEED SIMULATION TEST.

a. Set SPEED simulator on the 578L-1 to 500.
b. Set TRACK selector on the 578L-1 to 0.
c. Set ALONG TRACK dials on control unit to 50 (both stages).
d. Set MAN-AUTO switch on the control panel to AUTO.
e. Set TRACK ANGLE dial of the active stage on control panel to 0. The ALONG TRACK dial of the active stage will rotate, decreasing in its reading. As its reading reaches 0, the other ALONG TRACK dial will become active.
f. Set the TRACK ANGLE selector for the new active stage to 180 degrees.
g. Time the ALONG TRACK reading of this active stage. It should increase approximately 100 miles in 12 minutes.

5.6.4 CROSS TRACK SPEED SIMULATION TEST.

a. Set the SPEED simulator on 578L-1 to 500.
b. Set the TRACK selector on 578L-1 to 90.
c. Set the TRACK ANGLE dial for one stage to 180 degrees.
d. The CROSS TRACK dial should increase to the left or decrease to the right.
e. Time the CROSS TRACK dial reading. The time for 90 miles, right or left cross track, should be approximately 10 minutes, 48 seconds.

5.7 TEST SET 578L-1 CHASSIS REMOVAL.

The chassis of the 578L-1 can be removed from the case, for maintenance, by removing the eleven screws around the edge of the front panel (figure 5-2). The front panel can be folded back from the chassis by removing the remaining seven screws.

SECTION VI
PARTS LIST

Test Set 578L-1

ITEM	DESCRIPTION	COLLINS PART NUMBER
	TEST SET 578L-1	522-2062-00
B1	SYNCHRO TRANSMITTER: system voltage, 26 v, 400 cps single phase rotor, 3 phase stator; stator output voltage 11.8 v, stator resistance 3, ±20%; rotor resistance 8.5, ±20%	229-0076-00
B2	SYNCHRO TRANSMITTER: same as B1	229-0076-00
C1	CAPACITOR, FIXED, ELECTROLYTIC: 25 uf, 150 v dc, -15% +75%	184-7021-00
CR1	SEMICONDUCTOR DEVICE, DIODE: germanium G.E. 1N93	353-0201-00
DS1	LAMP, GLOW: neon bulb; 1/25 w, 65 v ac, 1-3/16 in. h over all	262-0021-00
E1 thru E7	TERMINAL STANDOFF: brass; 1/4 in. hex by 5/8 in. lg., tapped, 4-40 thd, 5/32 in. deep one end	306-0976-00
E8	NOT USED	
E9	TERMINAL STANDOFF: same as E1	306-0976-00
E10	TERMINAL STANDOFF: same as E1	306-0976-00
F1	FUSE, CARTRIDGE: 1.5 amps, 250 v., glass case, brass ferrules	264-4060-00
H1	WASHER, FLAT: CRES; 0.127 id, 0.250 od, .033 in. thk	502-1515-002
H2	GASKET, PANEL: neoprene, 13-13/16 in. lg overall, 15/16 in. thk, 4-7/32 in. w	546-9232-003
J1	CONNECTOR RECEPTACLE ELECTRICAL: 3 #16 male contacts, panel mounting, 1.031 in. by 1.031 in.	371-6078-00
K1	RELAY ARMATURE: 4 c contact arrangement, 250 v dc at 1 amp; 850 ohms ±10%, 48 v dc nom coil resistance; continuous duty cycle	974-0155-00
KD1	KNOB: set screw type; rd shape; black phenolic body; w/skirt; 1-29/64 in. dia by 0.875 in. thk	546-1294-003
P1	CONNECTOR, PLUG ELECTRICAL: 3 female contacts, cable mounting, 900 rms 1250 v dc 22 amps	371-6335-00
P1	CONNECTOR, ASSEMBLY: c/o 2 DPX inserts each having 57 female contacts and polarizing posts; 1190 v dc or 685 v ac 5 amps	370-2136-00
P2	CONNECTOR, ASSEMBLY: c/o 2 DPX inserts, each having 57 male contacts and polarizing posts; 1190 v dc or 685 v ac 5 amps	370-2135-00
P3	ELEMENT ASSEMBLY NO 33: c/o 3/16 in. dia 7 strand steel wire, zinc coated, clamped to steel tubing, galvanized finish, 1 in. od x 0.058 in. wall, 10 ft 8-11/16 in. lg by 2 stainless steel clamps & held in place by galvanized steel wire rope clip, 4 hinges & 2 hex cap screws	546-9628-003
P4	NOT USED	
P5	NOT USED	
P6	CONNECTOR PLUG: 3 male contacts, 10 amps at 250 v, 15 amps at 125 v	368-0099-00
R1	RESISTOR, FIXED, FILM: ±1%, 1,780 ohms, 1/4 w	705-7108-00
R2	RESISTOR, FIXED, FILM: ±1%, 2,150 ohms, 1/4 w	705-7112-00
R3	RESISTOR, FIXED, FILM: ±1%, 1,100 ohms, 1/4 w	705-7098-00
R4	RESISTOR, FIXED, FILM: ±1%, 12,100 ohms, 1/4 w	705-7148-00
R5	RESISTOR, FIXED, FILM: same as R1	705-7108-00
R6	RESISTOR, FIXED, FILM: same as R2	705-7112-00
R7	RESISTOR, FIXED, FILM: same as R3	705-7098-00
R8	RESISTOR, FIXED, FILM: same as R4	705-7148-00
R9	RESISTOR, VARIABLE, WIREWOUND: 20 ohms, ±10%, 0.8 w	381-1106-00
R10	RESISTOR, VARIABLE, WIREWOUND: same as R9	381-1106-00
R11	RESISTOR, FIXED, WIREWOUND: 800 ohms, ±5%, 11w	747-0249-00
R12	RESISTOR, FIXED, COMPOSITION: 56,000 ohms ±10%, 1/2 w	745-1426-00
S1	SWITCH, TOGGLE: DPDT 250 v dc at 5 amp, 30 v dc at 20 amp resistive; 220 v ac, 60 cps at 6 amp, 115 v ac at 15 amps resistive	266-5006-00
S2	SWITCH, TOGGLE: same as S1	266-5006-00
S3	SWITCH, ROTARY: one section, 2 positions, 20° detent, 6 moving contacts, 18 fixed contacts, 230 v ac, dc, 0.25 amp	259-1291-00
S4	SWITCH, TOGGLE: SPST, 250 v dc at 5 amp, 30 v dc at 20 amp resistive; 220 v ac, 60 cps at 6 amp, 115 v ac at 15 amps resistive	266-5011-00
S5	SWITCH, TOGGLE: same as S4	266-5011-00
T1	TRANSFORMER, POWER, STEP-UP AND STEP-DOWN: primary winding 115 v, 360 to 440 cps single phase; secondary winding 115 v at 1.00 amps, 26 v at 0.400 amps	662-0509-00
TB1	RESISTOR ASSEMBLY: plastic, glass cloth epoxy, 1-15/16 in. lg by 1-3/8 in. w by 1-16 in. thk board	546-9228-003
TB2	TERMINAL BOARD: plastic, glass cloth epoxy; c/o one resistor, one diode; 4 stud terminals, 1/16 in. thk by 2-9/32 in. lg by 13/16 in. w board	546-9236-003
XF1	FUSEHOLDER: extractor post type; 125 v, 15 amps, 11/16 in. dia by 2-9/64 in. lg overall	265-1019-00
XDS1	LAMPHOLDER: brass; accommodates T-3-1/4 lamp	262-0919-00
	COMMERCIAL HARDWARE	
	INSULATOR, WASHER: mica; 0.625 in. od, 0.203 in. id, 0.0312 in. thk (qty 2)	302-0348-00
	WASHER, FLAT: stainless steel; 0.125 in. id, 0.312 in. od, 0.027 in. thk (qty 11)	310-0045-00
	WASHER, FLAT: CRES; 0.172 in. id, 0.375 in. od, 0.036 in. thk (qty 17)	310-0047-00
	WASHER, LOCK: CRES; 0.168 id, 0.296 od, 0.040 thk (qty 6)	310-0072-00
	WASHER, LOCK: CRES; 0.088 in. id, 0.175 in. od, 0.020 in. thk (qty 4)	310-0275-00
	WASHER, LOCK: CRES; 0.115 in. id, 0.212 in. od, 0.025 in. thk (qty 74)	310-0279-00
	WASHER, LOCK: CRES; 0.141 in. id, 0.253 in. od, 0.031 in. thk (qty 29)	310-0282-00
	WASHER, LOCK: CRES; split helical ring; 0.168 in. id, 0.280 in. od, 0.031 in. thk (qty 2)	310-0283-00
	WASHER, FLAT: CRES; 0.147 in. id, 0.437 in. od. 0.0312 in. thk (qty 1)	310-0447-00
	NUT, SCREW MACHINE: stainless steel; 6-32 thd, 0.3125 in. hex max, 0.114 in. thk max (qty 9)	313-0002-00
	NUT, SCREW MACHINE: stainless steel; 8-32 thd, 11/32 in. lg, 1/8 in. thk (qty 6)	313-0017-00
	NUT, PLAIN, HEXAGON: CRES; 2-56 thd, 3/16 in. hex by 1/16 in. thk (qty 4)	313-0037-00
	NUT, PLAIN, HEXAGON: CRES; 4-40 thd, 1/4 in. hex, 3/32 in. thk (qty 16)	313-0043-00
	NUT, PLAIN, HEXAGON: CRES; 8-32 thd, 1/4 in. hex, 3/32 in thk (qty 2)	313-0046-00
	NUT, SELF-LOCKING, HEXAGON: dural, 4-40NC-2 thd, 0.250 in. hex, 0.141 in. h (qty 3)	333-0347-00
	NUT, SELF-LOCKING, HEXAGON: aluminum alloy; 2-56 NC-3B thd, 0.158 in. w across flats, 0.095 in. h o/a (qty 4)	333-0604-00
	SCREW, MACHINE: CRES; 4-40 NC-2A thd, Phillips recessed flat head, 3/16, in. lg (qty 8)	342-0043-00
	NUT, CAPTIVE: stainless steel; 6-32 NC-2B thd, 1/4 in. hex, 0.093 in. thk (qty 20)	334-0427-00
	NUT, PLAIN, HEXAGON: CRES; 3/8-32 thd, 1/2 in. hex, 3/32 in. thk (qty 1)	334-4120-00
	SETSCREW: CRES; multiple spline thd, 6 flutes, 3/16 in. lg (qty 2)	335-0041-00
	SCREW, MACHINE: stainless steel; passivate finish, flat head, 80 to 82° countersink, 4-40 NC-2A thd, 3/16 in. lg (qty 7)	342-0043-00
	SCREW, MACHINE: CRES; passivate finish, pan head, 2-56 NC-2A thd, 1/4 in. lg (qty 4)	343-0124-00

Test Set 578L-1

ITEM	DESCRIPTION	COLLINS PART NUMBER
	SCREW, MACHINE: CRES; Phillips pan head; 2-56 NC-2A thd, 1/2 in. lg (qty 4)	343-0128-00
	SCREW, MACHINE: CRES; Phillips pan head; 4-40 NC-2A thd; 3/16 in. lg (qty 6)	343-0132-00
	SCREW, MACHINE: stainless steel, pan head; 4-40 NC-2A thd, 1/4 in. lg (qty 4)	343-0133-00
	SCREW, MACHINE: stainless steel; pan head; 4-40 NC-2A thd, 5/16 in. lg (qty 23)	343-0134-00
	SCREW, MACHINE: CRES; Phillips pan head; 4-40 NC-2A thd, 3/8 in. lg (qty 24)	343-0135-00
	SCREW, MACHINE: CRES; Phillips pan head; 4-40 NC-2A thd, 7/16 in. lg (qty 4)	343-0136-00
	SCREW, MACHINE: stainless steel; passivate finish, pan head; 4-40 NC-2A thd, 7/8 in. lg (qty 3)	343-0140-00
	SCREW, MACHINE: CRES; Phillips recessed pan head, 6-32 NC-2A thd, 1/4 in. lg (qty 17)	343-0167-00
	SCREW, MACHINE: CRES; Phillips recessed pan head, 6-32 NC-2A thd, 3/8 in. lg (qty 3)	343-0169-00
	SCREW, MACHINE: CRES; Phillips recessed pan head, 6-32 NC-2A thd, 7/16 in. lg (qty 4)	343-0170-00
	SCREW, MACHINE: CRES; Phillips pan head; 8-32 NC-2A thd, 1/2 in. lg (qty 6)	343-0189-00
	SCREW, MACHINE: CRES; pan head; cross recess drive; 8-32 NC-2A thd., 5/8 in. lg (qty 11)	343-0190-00
	SCREW, MACHINE: stainless steel; fillister head, 4-40 NC-2A thd, 5/16 in. lg (qty 4)	347-0007-00
	SCREW, MACHINE: CRES; cross recess drive, 4-40 NC-2A thd, 3/8 in. lg (qty 7)	347-0008-00
	SCREW, MACHINE: stainless steel; passivate finish, fillister head; 6-32 NC-2A thd, 3/8 in. lg (qty 2)	347-0035-00
	WASHER, LOCK: stainless steel; internal teeth, 0.391 in. id, 0.507 in. od, 0.022 in. thk (qty 1)	373-0085-00

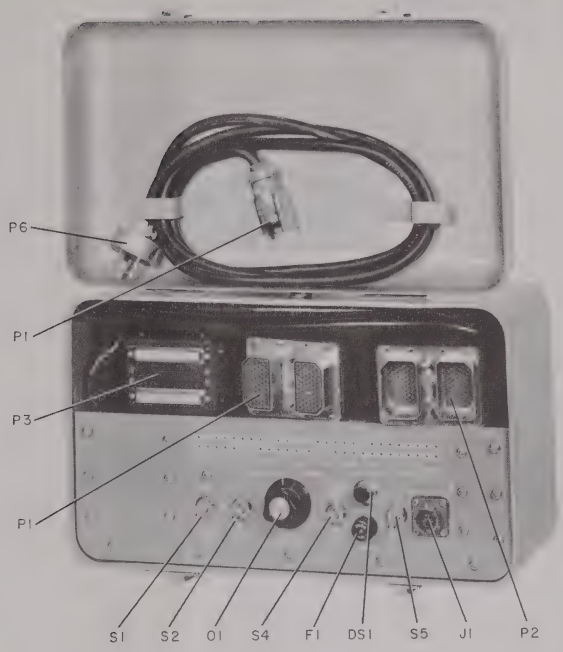


Figure 6-1. Test Set 578L-1, Over-all View

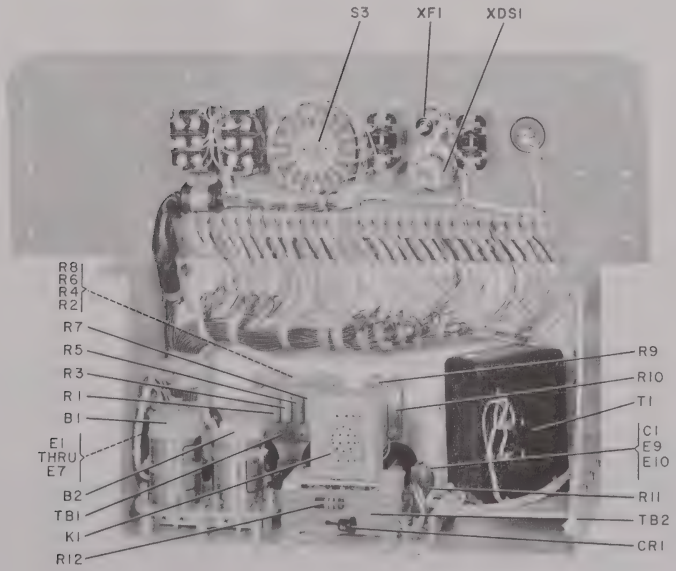


Figure 6-2. Test Set 578L-1, Chassis with Case Removed and Front Panel Folded Back

SECTION VII
ILLUSTRATIONS

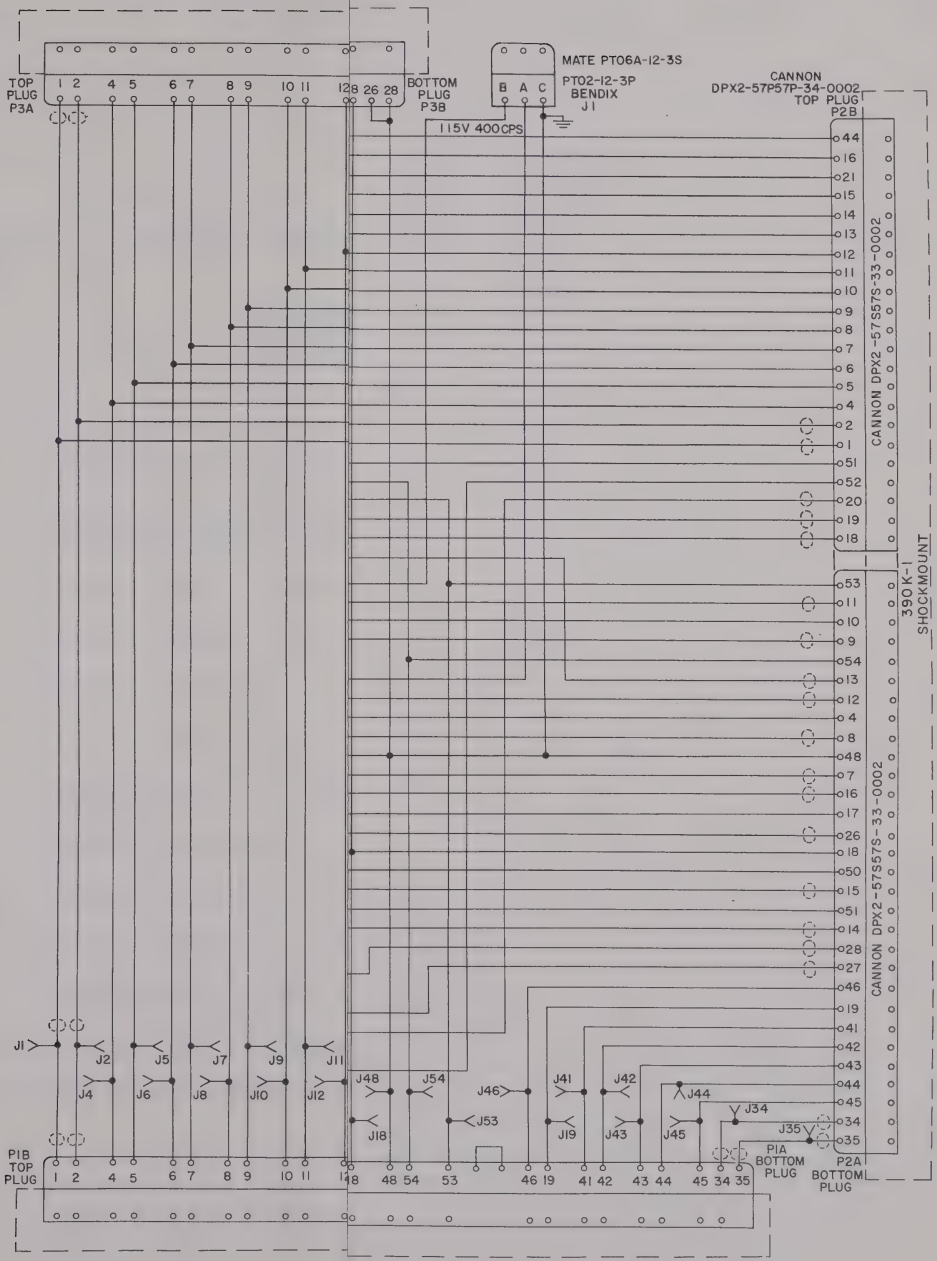

TOP PLUG P3A
1 2 4 5 6 7 8 9 10 11 12 26 28
BOTTOM PLUG P38
MATE PT06A-12-3S
PT02-12-3P BENDIX J1
B A C
115V 400CPS
CANNON DPX2-57P57P-34-0002 TOP PLUG P2B
CANNON DPX2-575575-33-0002
CANNON DPX2-575575-33-0002
390K-1 SHOCKMOUNT
J1 J2 J5 J7 J9 J11
J4 J6 J8 J10 J12
J48 J54 J46 J41 J42 J44 J34
J18 J53 J19 J43 J45 J35
P1B TOP PLUG
P1A BOTTOM PLUG
P2A BOTTOM PLUG

Figure 7-1. Test Set 578L-1, Over-all Schematic Diagram

SECTION VII
ILLUSTRATIONS

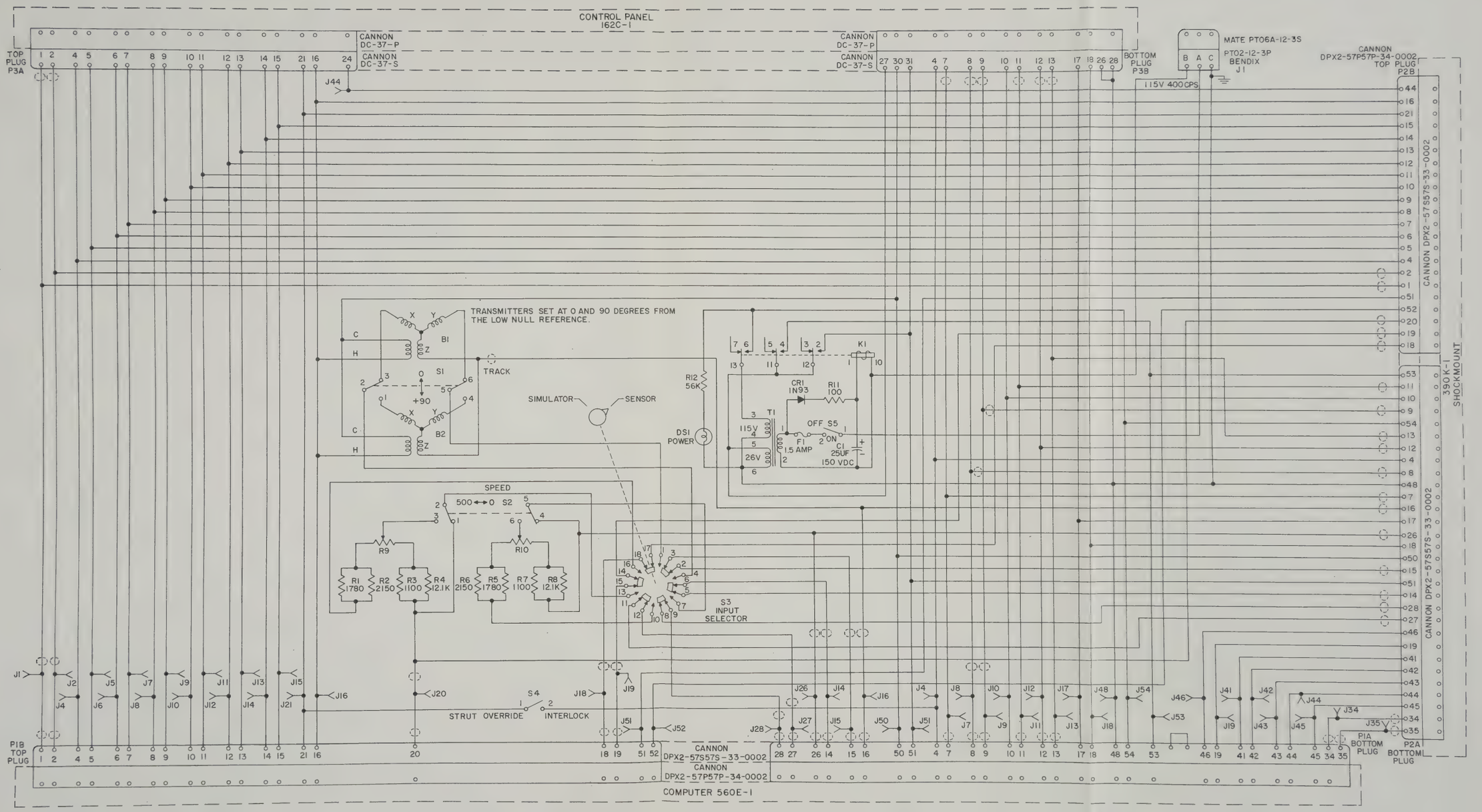


Figure 7-1. Test Set 578L-1, Over-all Schematic Diagram

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA, U.S.A.

CABLE
COLINRAD

July 15, 1961

O: HOLDERS OF FREQUENCY DISCRIMINATOR TEST PANEL 578Q-1 INSTRUCTION BOOK

REVISION NO. 1 HIGHLIGHTS

PAGE NO.	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
1-0	Revised figure 1-1 to include plugs furnished.	All models
1-1	Revised table 1-1 to include power plug connectors and instruction book furnished.	All models
2-1	Revised figure 2-1 to include jack identification.	All models
2-1	Added paragraph 2.5 for clarification.	All models
3-1	Revised paragraph 3.2.a for clarification.	All models
4-1	Revised paragraph 4.2.1 for clarification.	All models
4-1	Revised figure 4-1 for clarification.	All models
5-1	Revised paragraphs 5.1.2 and 5.1.3 for clarification.	All models
5-1	Revised paragraph 5.1.3.a to correct error.	All models
6-3	Revised figure 6-2 to add identification of TB1.	All models
6-4	Transposed figure titles to correct error.	All models
7-1/7-2	Revised figure 7-1 for clarification.	All models

FREQUENCY DISCRIMINATOR TEST PANEL

578Q-1

INSTRUCTION BOOK

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RECORD OF REVISIONS

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1	July 15/61						

RETAIN THIS RECORD IN THE FRONT OF MANUAL OR CHAPTER.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.

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Figure 1-1. Frequency Discriminator Test Panel 578Q-1

SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF THE 578Q-1.

Frequency Discriminator Test Panel 578Q-1, Collins part number 522-2066-00, is to be used for testing and aligning discriminators types 1 and 2, Collins part numbers 544-0058-00 and 544-0059-00, respectively. These discriminators are modules of Computer/ Tracker 562F-1B, a component of Collins Doppler Radar Navigation System DN-101.

1.2 EQUIPMENT SUPPLIED AND EQUIPMENT NOT SUPPLIED.

Table 1-1 lists the equipment supplied. Table 1-2 lists additional equipment required but not supplied. Suitable substitutes for equipments listed in table 1-2 may be used.

TABLE 1-1
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
Frequency Discriminator Test Panel	522-2066-00
Connector, P9	368-0015-00
Connector, P10	368-0010-00

TABLE 1-2
EQUIPMENT REQUIRED BUT NOT SUPPLIED

EQUIPMENT	EQUIPMENT TYPE OR COLLINS PART NUMBER
Doppler Tracker Signal Simulator 476F-1A	522-2540-00
D-C Vacuum-Tube Voltmeter	Heathkit V7A

NOTE

A signal generator substituted for the 476F-1A must be capable of delivering 1.0-volt input to the 578Q-1 at the following frequencies and accurate to within the tolerance given:

155.500 kc ±1.0 cps
158.875 kc ±1.0 cps
162.250 kc ±1.0 cps

1.3 CHARACTERISTICS OF THE 578Q-1.

Modes of Operation	Two modes of servo operation: frequency positioning and bridge
Type of Service	Continuous
Dimensions	19 x 8-21/32 x 6-1/2 inches
Weight	7 lb
Type Mounting	Rack panel construction
Service Conditions	Shop ambient
Power Source	115 volts ±10 percent, 380-420 cps
	27.5 volts ±10 percent, d-c
Input Signal	From Doppler Signal Simulator 476F-1A, or equivalent
Controls	POWER, ON-OFF
	CHOPPER, ON-OFF
	RATE FEEDBACK, ON-OFF
	PAWL, IN-OUT
	POTENTIOMETER GANG selector
	Servo MOTOR, ON-OFF
	TRACKING LINEARITY
	CALIBRATE LINEARITY
	BRIDGE POSITION selector
	POSITIONING MODE, BRIDGE-FREQUENCY
	BRIDGE, OPERATE-CALIBRATE

SECTION II
INSTALLATION

2.1 UNPACKING.

Unpack the 578Q-1 with care, and inspect the unit for possible shipping damage. If a claim for damage is filed with the transportation agency, it is advisable to retain the shipping cartons.

2.2 BENCH TEST.

The 578Q-1 should be in operating condition when received. If the performance of the unit is unsatisfactory, perform the tests outlined in section V.

2.3 MOUNTING AND CABLING.

The 578Q-1 is designed for mounting in a 19-inch rack panel. The unit should be secured to the rack with four mounting screws and four washers. The 578Q-1 may be set up as an independent unit without rack mounting, if desired. Suitable power connectors and cables are to be connected to the chassis-mounted connectors. See figure 2-1 for outline and mounting dimensions and power connector types and location.

2.4 INITIAL ADJUSTMENTS.

Remove and inspect the two fuses mounted on the front panel. Ensure that they are the proper value and continuous. Turn the POWER and CHOPPER switches to OFF position prior to connecting the power sources.

2.5 CABLE FABRICATION

Fabricate power cables for the 578Q-1 incorporating the connectors furnished (see table 1-1). Use applicable connectors on the free ends of the cables.

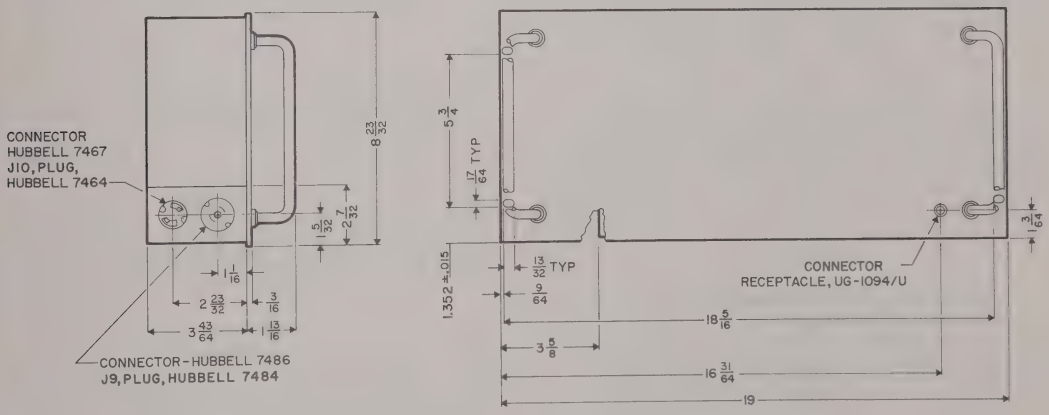

Figure 2-1. Outline and Mounting Dimensions, 578Q-1

SECTION III
OPERATION

3.1 CONTROLS.

3.1.1 MOTOR.

The MOTOR OFF-ON switch is S6 on the schematic diagram, figure 7-1. This switch opens and closes the servo motor positioning circuit of the discriminator under test.

3.1.2 CHOPPER.

The CHOPPER OFF-ON switch is S2 on the schematic diagram, figure 7-1. This switch opens and closes the solenoid circuit of the chopper G1 within the 578Q-1.

3.1.3 POWER.

The POWER OFF-ON switch is S1 on the schematic diagram, figure 7-1. This switch opens and closes the primary circuit of the power transformer, T1.

3.1.4 TRACKING LINEARITY.

The TRACKING LINEARITY control is R14 on the schematic diagram, figure 7-1. This control is used during discriminator module calibration tests, see paragraph 3.2.

3.1.5 CALIBRATE LINEARITY.

The CALIBRATE LINEARITY control is R17 on the schematic diagram figure 7-1. This control is used during discriminator module calibration tests, see paragraph 3.2.

3.1.6 POTENTIOMETER GANG.

The POTENTIOMETER GANG selector is S5 on the schematic diagram, figure 7-1. This selector is used to choose a single potentiometer of the discriminator module for testing and/or calibrating.

3.1.7 BRIDGE POSITION.

The BRIDGE POSITION selector is S8 on the schematic diagram, figure 7-1. This selector is used to choose bridge components within the 578Q-1 for discriminator module alignment.

3.1.8 BRIDGE OPERATE-CALIBRATE.

The BRIDGE OPERATE-CALIBRATE switch is S9 on the schematic diagram, figure 7-1. The CALIBRATE position is used while calibrating the 578Q-1 against an external standard. See section V. The OPERATE position is used during discriminator module testing and aligning.

3.1.9 POSITIONING MODE.

The POSITIONING MODE switch is S7 on the schematic diagram, figure 7-1. This switch is used to select the servo motor control source, either the bridge network of the 578Q-1, or the discriminator of the discriminator module under test.

3.1.10 PAWL.

The PAWL IN-OUT switch is S4 on the schematic diagram, figure 7-1. This switch opens and closes the circuit of the solenoid of L3, the pawl actuator, in the frequency discriminator module.

3.1.11 RATE FEEDBACK.

The RATE FEEDBACK switch is S3 on the schematic diagram, figure 7-1. This switch opens and closes the circuit for 400-cps current through the stator winding of the servo generator located within the frequency discriminator module under test.

3.2 DISCRIMINATOR MODULE TESTING.

a. Mount and secure the frequency discriminator module to the front panel of the 578Q-1 with the module captive mounting screws. Ensure that the 578Q-1 is connected to the proper power sources; see paragraph 1.3.

NOTE

Frequency discriminators type 1 and type 2 are keyed to mate only one way with the front panel of the 578Q-1. Refer to the silk screening on the front panel of the 578Q-1 for type 1 and type 2 orientation.

Frequency discriminators type 1 and type 2 each have a connector of type DC-37P which mates with type DC-37S connector which is mounted on the front panel of the 578Q-1.

b. Move the POWER switch of the 578Q-1 to ON position.

c. Connect one end of a coaxial cable to the RF IN/OUT connector located on the front of Doppler Tracker Signal Simulator 476F-1A, (see table 1-2). Connect the other end of the coaxial cable to the INPUT connector on the 578Q-1.

d. Position the FREQUENCY selector of the 476F-1A to 158.875.

e. Move the POWER switch on the 476F-1A to ON position.

f. Connect the d-c vtvm (see table 1-2) between the FLAG OUTPUT jack and ground on the 578Q-1.

g. Adjust the RF OUTPUT control on the 476F-1A to obtain 2.75 ±0.2 volts as indicated on the d-c vtvm of step f. above.

h. Position the controls of the 578Q-1 as follows:

POWER	ON
CHOPPER	ON
MOTOR	ON
RATE FEEDBACK	OFF
POSITIONING MODE	FREQUENCY
BRIDGE SWITCH	OPERATE
BRIDGE POSITION	C
POTENTIOMETER GANG	A

i. Hold the PAWL switch to IN position, and move the RATE FEEDBACK switch to ON position.

j. After three seconds, release the PAWL switch, and allow it to return to OUT position.

k. Remove the d-c vtvm of step f above, and connect it between the DISCRIMINATOR OUTPUT jack and ground.

l. Move the POSITIONING MODE switch to BRIDGE position.

NOTE

The indicator needle of the vtvm may oscillate slightly. This is a normal occurrence.

m. Adjust the CALIBRATE LINEARITY control to a null as indicated on the d-c vtvm of step k above. The null should occur with the CALIBRATE LINEARITY control between the limits of -.15 and +.15.

n. Position the POTENTIOMETER GANG selector to B.

o. Repeat step m above for each of the POTENTIOMETER GANG positions, B, C, and D.

p. Return the POTENTIOMETER GANG selector to position A.

q. Remove the d-c vtvm of step k above, and connect it between the FLAG OUTPUT jack and ground.

r. Position the FREQUENCY selector of the 476F-1A to 155.500.

s. Adjust the RF OUTPUT control of the 476F-1A to obtain 2.75 ±0.2 volts as indicated on the d-c vtvm of step q.

t. Remove the d-c vtvm of step q from the FLAG OUTPUT jack, and connect it between the DISCRIMINATOR OUTPUT jack and ground.

u. Move BRIDGE POSITION selector to position B.

v. Adjust the TRACKING LINEARITY control to obtain a null as indicated on the d-c vtvm of step t above. The null indication should occur with the TRACKING LINEARITY control between the limits of -.15 and +.15.

w. Move the POTENTIOMETER GANG to position B.

x. Repeat step v above with POTENTIOMETER GANG in each of the positions, B, C, and D.

y. Remove the d-c vtvm from the DISCRIMINATOR OUTPUT jack, and connect it between the FLAG OUTPUT jack and ground.

z. Move the FREQUENCY selector of the 476F-1A to 158.875 position, and adjust the RF OUTPUT control to obtain 2.75 ±0.2 volts as indicated on the d-c vtvm.

aa. Remove the d-c vtvm of step y from the FLAG OUTPUT, and connect it between the DISCRIMINATOR OUTPUT jack and ground.

ab. Move the BRIDGE POSITION selector to C-, and record the magnitude and polarity of the indication on the d-c vtvm.

ac. Move the BRIDGE POSITION selector to C+, and observe the magnitude and polarity of the indication on the d-c vtvm. The indication must be of opposite polarity and of a magnitude within ±0.1 volt d-c of the indication recorded in step ab above.

ad. Remove the d-c vtvm from the DISCRIMINATOR OUTPUT jack, and connect it between the FLAG OUTPUT jack and ground.

ae. Move the BRIDGE POSITION selector to position D.

af. Move the POSITIONING MODE switch to BRIDGE.

ag. Move the FREQUENCY selector of the 476F-1A to 162.250 position.

ah. Adjust the RF OUTPUT control of the 476F-1A to obtain 2.75 ±0.2 volts indicated on the vtvm of step ad above.

ai. Remove the d-c vtvm from the FLAG OUTPUT jack, and connect it between the DISCRIMINATOR OUTPUT jack and ground.

aj. Observe the indication on the d-c vtvm. The indication should be 0 ±150 millivolt.

3.3 DISCRIMINATOR MODULE ALIGNMENT.

3.3.1 ADJUSTING CALIBRATE LINEARITY.

The following procedure is performed to establish the position of the CALIBRATE LINEARITY control on the 578Q-1.

a. Observe the tag on the potentiometer case. (An example of the tag follows: 183.7° = 51.898 %)

b. Record the percent (%) figure and subtract 51.890 algebraically from the recorded figure. The difference value as a result of the preceding subtraction may be positive or negative.

c. Set the CALIBRATE LINEARITY control to the position corresponding to the positive or negative difference value obtained in step b above.

3.3.2 RESONANT CIRCUITS ADJUSTMENT.

Mount the frequency discriminator module on the front panel of the 578Q-1. Set the controls of the 578Q-1 to the following positions:

SECTION IV
PRINCIPLES OF OPERATION

4.1 BLOCK DIAGRAM.

Figure 4-1 is a partial block diagram of Frequency Discriminator Test Panel 578Q-1 and discriminator module.

4.2 MODES OF OPERATION.

Frequency Discriminator Test Panel 578Q-1 operates the servo system of the discriminator module under test in either of two modes. The two modes of operation are bridge and discriminator output.

4.2.1 BRIDGE POSITIONING MODE.

See block diagram, figure 4-1. The 400-cps signal between terminal 6 of T1 and ground excites winding 9 to 4 of the servo generator in the frequency discriminator module under test. The 400-cps signal between terminal 5 of T1 and ground excites winding 0 to 2 of the servo motor in the frequency discriminator module under test. Position signal from the resistance bridge, composed of R_A, R_B, R_C, R_D, and winding 1 to 5 of the servo generator, is

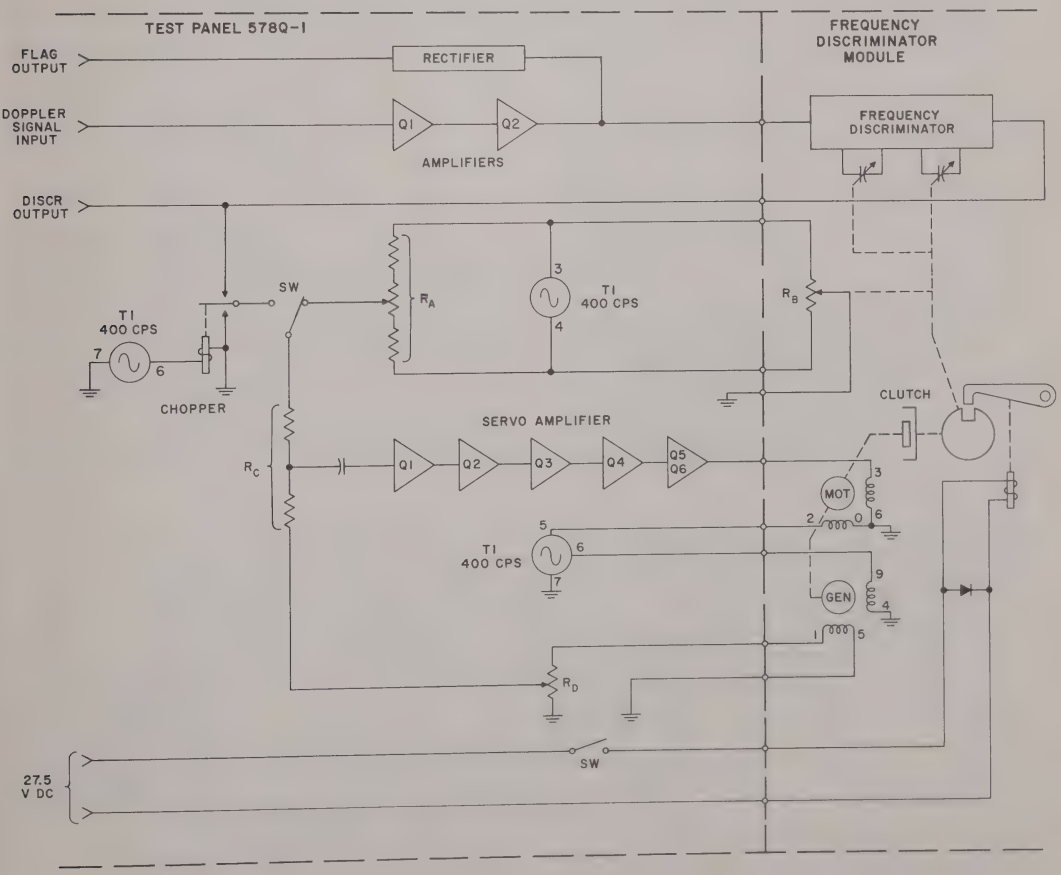

Figure 4-1. Block Diagram, Frequency Discriminator Test Setup

fed to servo amplifier, Q1 through Q6. Servo position signal from the servo amplifier is fed to rotor winding 3 to 6 of the servo motor. The servo motor is mechanically coupled to the discriminator potentiometer, R_B, so that as the motor turns, the potentiometer is turned to a new position such that the position signal from the discriminator potentiometer, R_B, and the resistor-potentiometer network, R_A-RC-R_D, of the 578Q-1, is zero. Thus the servo motor position is a function of the position of the bridge network potentiometer, RA, of Frequency Discriminator Test Panel 578Q-1.

4.2.2 DISCRIMINATOR OUTPUT MODE.

Doppler signal is applied to a two-stage transistor amplifier and fed to the frequency discriminator network of the frequency discriminator under test. D-c output from the discriminator is fed through chopper G1 to the servo amplifier Q1 through Q6. The output from the servo amplifier is fed to the servo motor as in BRIDGE POSITIONING MODE, paragraph 4.2.1. The servo motor is mechanically coupled to the discriminator tuning capacitors. As the motor turns, the capacitors are turned to the position which causes zero output to be obtained from the frequency discriminator. Therefore the position of the servo motor is a function of the frequency of the doppler input signal.

SECTION V
MAINTENANCE

5.1 TESTING.

5.1.1 TEST EQUIPMENT REQUIRED.

The following test equipments or their equivalents are required for testing and adjusting Frequency Discriminator Test Panel 578Q-1.

Dekavider Model DV411

VTVM, Ballantine Model 300

Voltohmmeter, Triplett Model 630

Signal Generator, Hewlett-Packard Model 200CD

Test jig (figure 5-1)

Resistor 5 ohm 1/2 watt

Power source 27.5 ±5% volts d-c

Power source 115 ±5% volts 400 cps

5.1.2 PRELIMINARY TESTS.

Connect the 5-ohm 1/2-watt resistor across CR1 in the 578Q-1 servo amplifier (see schematic diagram figure 7-1). Connect the test jig, figure 5-1, to J11 of the Frequency Discriminator Test Panel 578Q-1.

5.1.2.1 CONTINUITY CHECK.

Check for continuity between the following pins of the test jig, figure 5-1.

J1-J2	J20-J37
J2-J3	J21-J36
J3-J4	J23-J34
J5-J7	J24-J33
J7-J9	J33-ground
J9-J11	J17-FLAG jack of the 578Q-1

5.1.3 OPERATION CHECK.

Connect the test jig, figure 5-1, to J11 of the 578Q-1. Connect 27.5 v d-c and 115 v 400 cps to the proper connectors, J9 and J10 (see figure 2-1). Set the controls of the 578Q-1 to the following positions.

MOTOR	OFF
CHOPPER	OFF
POWER	OFF
RATE FEEDBACK	OFF
PAWL	OUT
POSITIONING MODE	FREQUENCY
BRIDGE	CALIBRATE

a. Move the POWER switch to ON. The power monitor light on the 578Q-1 should illuminate.

b. Remove the 1/32-ampere fuse from the front panel of the 578Q-1, and replace it with a 1/2-ampere fuse.

c. Move the PAWL switch to IN. The PAWL light on the test jig should illuminate.

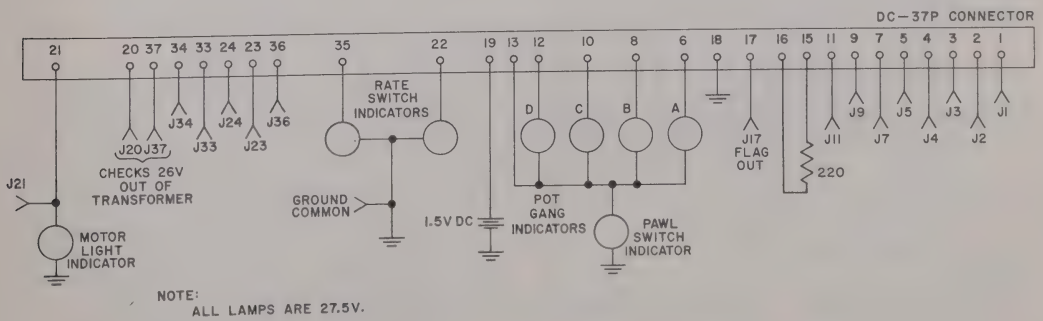

Figure 5-1. Test Jig for Frequency Discriminator Test Panel 578Q-1

d. Move the RATE FEEDBACK switch to ON. Both RATE lights on the test jig should illuminate. Return the RATE FEEDBACK switch to OFF.

e. Move the PAWL switch to IN position and hold. Move the POTENTIOMETER GAIN selector to position A, position B, position C, and position D; the respective lights on the test jig should illuminate. Release the PAWL switch. Remove the 1/2-ampere fuse substituted in step b, and replace the 1/32-ampere fuse.

f. Move the CHOPPER switch to ON. The chopper hum should be heard.

g. Move the MOTOR switch to ON. The MOTOR lamp on the test jig should illuminate.

h. Move the CHOPPER switch to OFF. The MOTOR lamp on the test jig should go off.

NOTE

If the MOTOR lamp does not go off in step h, reduce the value of the 5-ohm resistor of paragraph 5.1.2 to such a value that the lamp does go off when the procedure of step h is accomplished.

Return the CHOPPER switch to ON position.

i. Set the POSITIONING MODE selector to BRIDGE. The MOTOR lamp of the test jig should go off.

j. Connect a jumper between the EXTERNAL BRIDGE LOW jack and ground.

k. Move the BRIDGE switch to OPERATE position. The MOTOR lamp on the test jig should go on when the BRIDGE POSITION selector is in any position except VAR.

l. Remove the jumper of step j above. Remove the 5-ohm resistor of paragraph 5.1.2.

CAUTION

Never ground any of the EXTERNAL BRIDGE jacks except in the sequence outlined above.

5.1.4 VOLTAGE MEASUREMENTS.

Measure voltage between points indicated in table 5-1; the proper voltages are indicated in table 5-1.

TABLE 5-1
VOLTAGE CHART

POINTS	VOLTS	A-C OR D-C
J1 to J11 of test jig	26 ±2	A-c
HI to LOW of EXTERNAL BRIDGE jack	26 ±2	A-c
J20 to test jig to ground	26 ±2	A-c
Pin 3 to ground of servo amplifier socket (servo amplifier removed)	26 ±2.5	D-c

TABLE 5-1
VOLTAGE CHART (Cont)

POINTS	VOLTS	A-C OR D-C
Pin 13 to ground of servo amplifier socket (servo amplifier removed)	20 ±1	D-c
DISCRIMINATOR OUTPUT jack to ground	1.5 ±0.2	D-c

Apply 1.0 volt a-c 155.0 kc to the coaxial INPUT of the 578Q-1, and measure the d-c voltage at the FLAG OUTPUT of the 578Q-1. This voltage should be 2.0 ±0.2 volts d-c.

5.2 POTENTIOMETER ADJUSTMENTS.

a. Set the BRIDGE switch to CALIBRATE position.

b. Connect the Dekavider between the EXTERNAL BRIDGE HIGH and LOW jacks of the 578Q-1.

c. Connect an a-c voltmeter between the EXTERNAL BRIDGE WIPER and BRIDGE CALIBRATE jacks.

d. Set the Dekavider to 0387.

e. Set the BRIDGE POSITION selector to position A, and adjust R11 for a null as indicated on the a-c voltmeter of step c.

f. Set the Dekavider to 0669.5.

g. Set the BRIDGE POSITION selector to position B.

h. Adjust the TRACKING LINEARITY control to obtain a null on the a-c voltmeter of step c above.

i. Loosen the setscrews in the TRACKING LINEARITY control knob; set the knob pointer to zero and tighten the setscrews. Ensure that the -.15 and +.15 marks fall within the range of the control. Ensure that the wiper arm of the potentiometer makes contact as the control knob is rotated between the -.15 mark and the +.15 mark.

j. Set the BRIDGE POSITION selector to position C-.

k. Adjust the Dekavider to obtain a null as indicated on the a-c voltmeter of step c. At the null point, the Dekavider should indicate 3850.0 ±67 ohms.

l. Set the BRIDGE POSITION selector to position C.

m. Set the Dekavider to 5189.3.

n. Adjust the CALIBRATE LINEARITY control to obtain a null indication on the a-c voltmeter of step c.

o. Loosen the setscrews of the CALIBRATE LINEARITY control knob, set the pointer of the knob to zero, and tighten the setscrews. Ensure that the wiper arm of the potentiometer makes contact as the control knob is rotated between the -.15 and +.15 marks.

p. Set the BRIDGE POSITION selector to position C+.

q. Adjust the Dekavider to obtain a null indication on the a-c voltmeter of step c. At the null point, the Dekavider should indicate 6528.0 ±67 ohms.

r. Set the BRIDGE POSITION control to position D.

s. Set the Dekavider to 9709.0 ohms.

t. Adjust R20 for a null indication on the a-c voltmeter of step c.

u. Remove the voltmeter of step c.

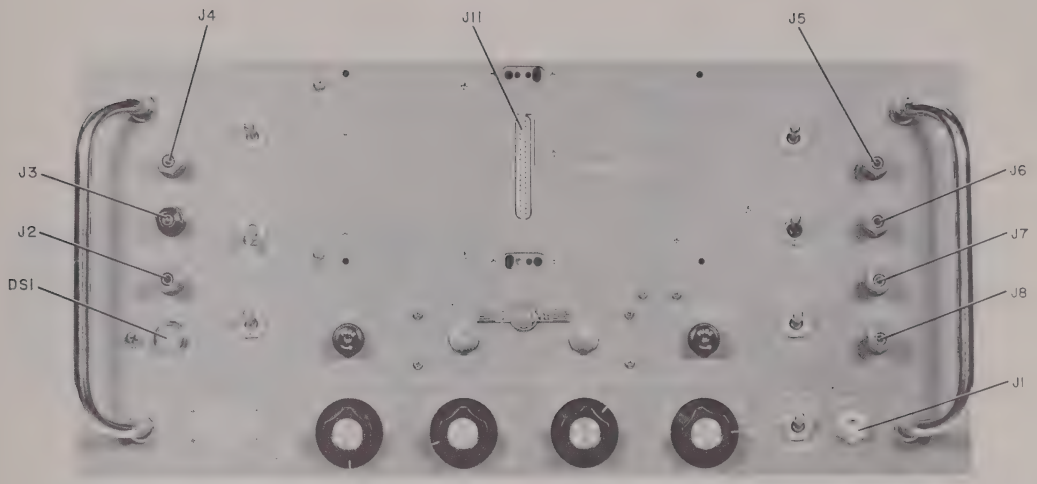

Figure 6-1. Front Panel, Parts Placement

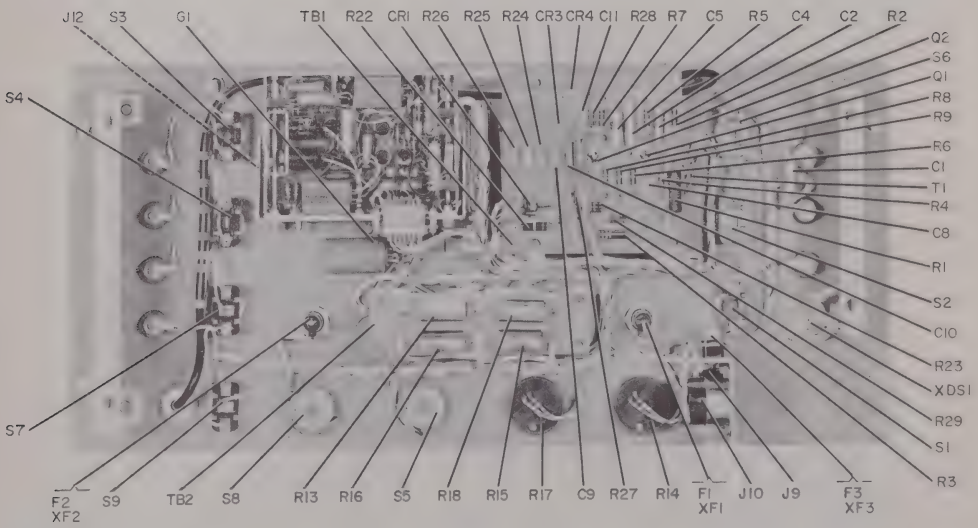

Figure 6-2. Rear View, Parts Placement

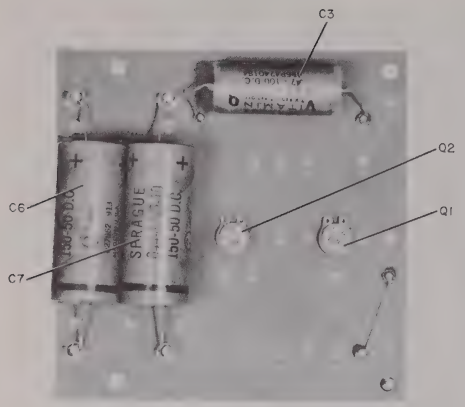

Figure 6-3. Terminal Board Number 1, Parts Placement

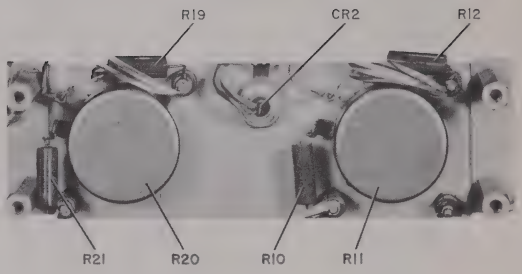

Figure 6-4. Under Terminal Board Number 2, Parts Placement

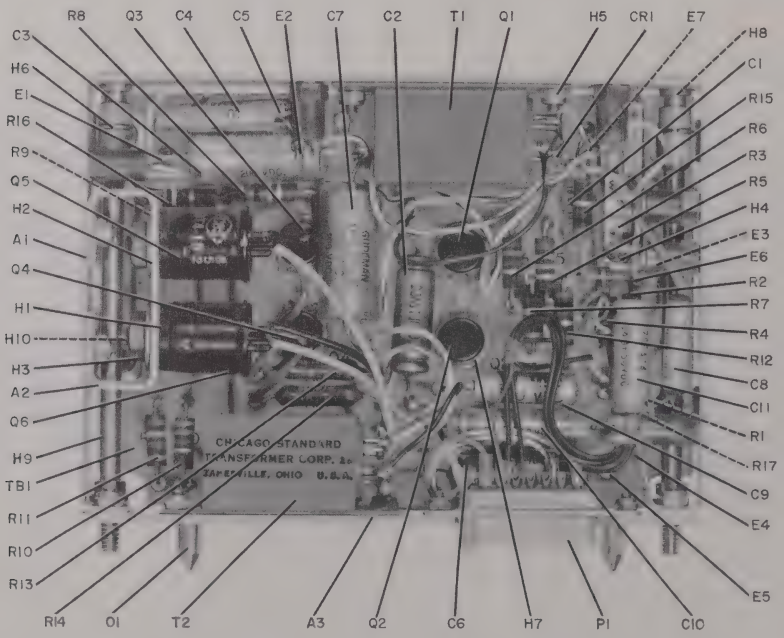

Figure 6-5. Servo Amplifier Module, Parts Placement

SECTION VII
ILLUSTRATIONS

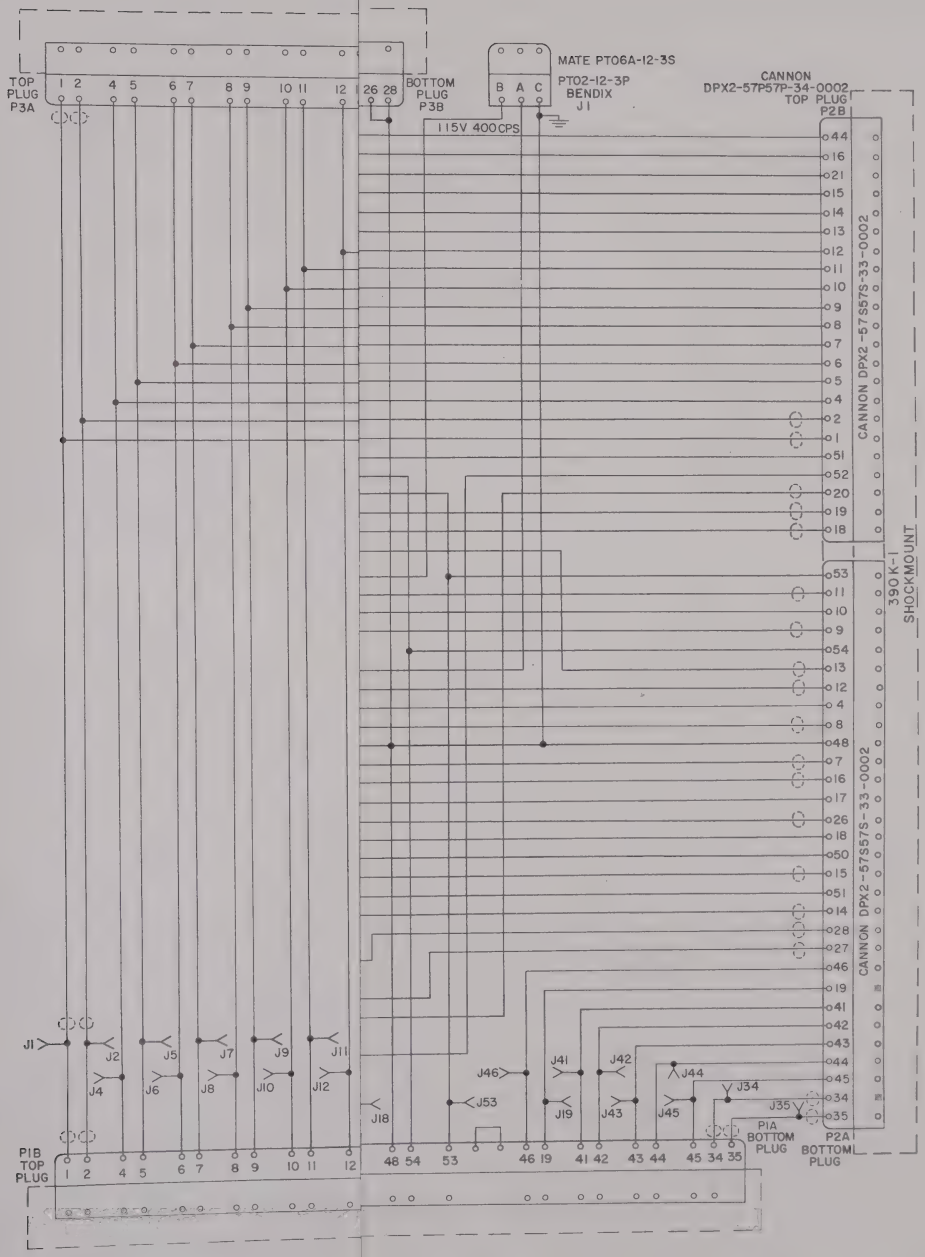
TOP PLUG P3A
1 2 4 5 6 7 8 9 10 11 12
BOTTOM PLUG P3B
26 28
MATE PT06A-12-3S
PT02-12-3P BENDIX J1
B A C
115V 400CPS
CANNON DPX2-57P57P-34-0002 TOP PLUG P2B
CANNON DPX2-57S57S-33-0002
CANNON DPX2-57S57S-33-0002
390K-1 SHOCKMOUNT
J1 J2 J4 J5 J6 J7 J8 J9 J10 J11 J12
J18 J53 J46 J41 J42 J44 J19 J43 J45 J34 J35
P1A BOTTOM PLUG
P2A BOTTOM PLUG
P1B TOP PLUG
1 2 4 5 6 7 8 9 10 11 12
48 54 53 46 19 41 42 43 44 45 34 35

Figure 7-1. Test Set 578L-1, Over-all Schematic Diagram

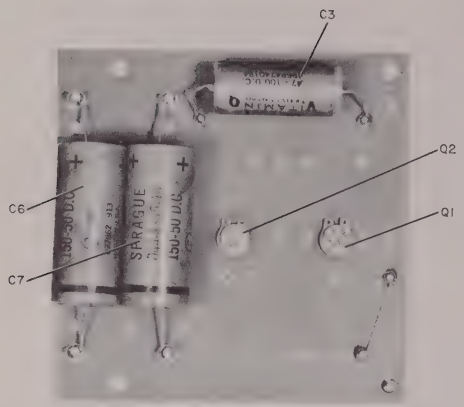

Figure 6-3. Terminal Board Number 1, Parts Placement

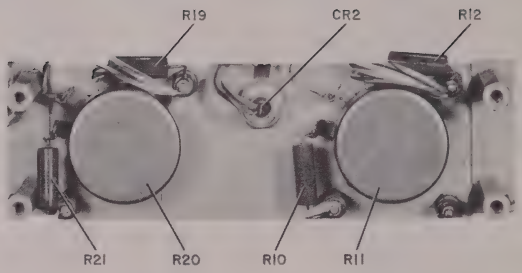

Figure 6-4. Under Terminal Board Number 2, Parts Placement

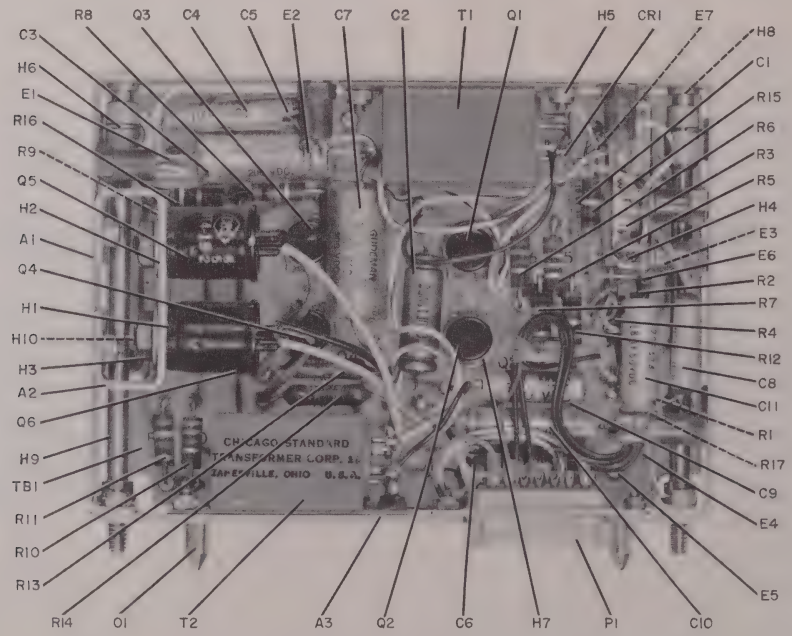

Figure 6-5. Servo Amplifier Module, Parts Placement

SECTION VII
ILLUSTRATIONS

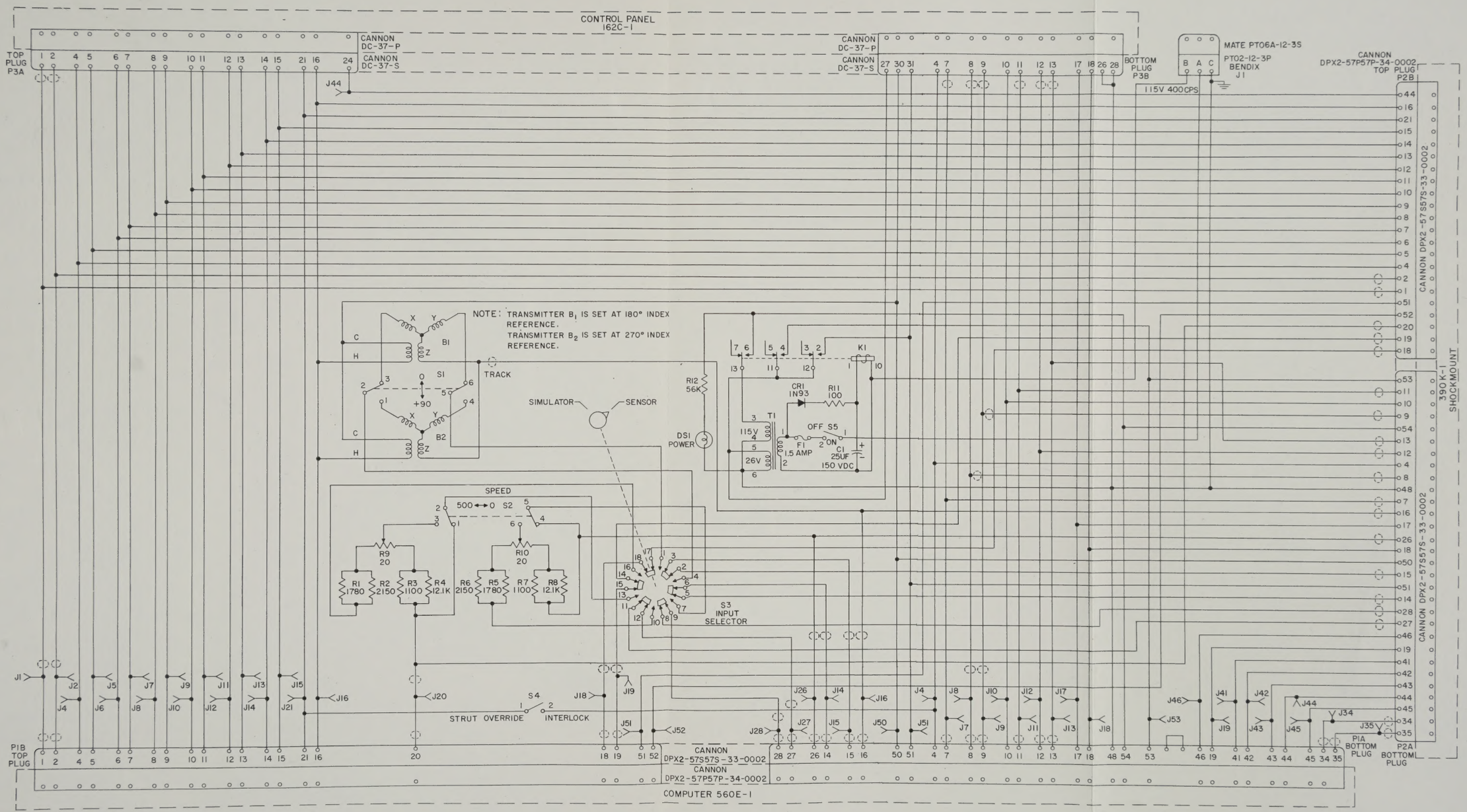

Figure 7-1. Test Set 578L-1, Over-all Schematic Diagram

ELECTRICAL WIRE CODE

EXAMPLES

UNSHIELDED WIRE, MIL TYPE B #22 AWG, WHITE WITH RED AND GREEN TRACERS:

D	A	9	25	—	4-1/4
Type of Wire	Size of Wire	Color of Body	Color of Tracers		Length of Wire in Inches (Includes Stripping & Tinning)

SHIELDED WIRE (SINGLE), MIL TYPE C, #15 AWG, WHITE WITH RED AND GREEN TRACERS:

R	D	S	9	25	—	4-1/4
Type of Wire	Size of Wire	Shielded	Color of Body	Color of Tracers		Length of Wire in Inches (Includes Stripping & Tinning)

SHIELDED WIRE (MULTIPLE), MIL TYPE B, #22 AWG, WHITE, AND WHITE WITH RED TRACER:

D	A	S	(9)	(92)	—	4-1/4
Type of Wire	Size of Wire	Shielded	First Conductor	Second Conductor		Length of Wire in Inches (Includes Stripping & Tinning)

TYPE OF WIRE CODE		
LETTER	TYPE OF WIRE	FAMILY USUALLY FOUND IN
A	Cotton Braid Over Plastic (Formerly AN-J-C-48)	440 Plain 443 Shielded
B	Busbar, Round Tinned	421
C	MIL-W-16878 Type B (#20 and Larger) (600 Volts)	439
D	Miniature Wire, MIL-W-16878 Type B (#22 & Smaller)	439-7000 Series
E		
F	Extra Flexible Varnished Cambric	423
G		
H	Kel-F (Monochloro-trifluoroethylene)	422
J		
K	Neon Sign Cable (15,000 Volts)	423 0004 00
L	Silicone	425 0942 00
M		
N	Single Conductor Stranded (Not Rubber Covered)	422
P	Single Conductor Stranded (Rubber Covered)	423
Q		
R	MIL-W-16878 Type C (1000 Volts)	439 1000 Series
T	Teflon, MIL-W-16878 Type E (600 Volts)	439 4000 Series
V	MIL-W-16878 Type D (3000 Volts)	439 3000 Series
W	Teflon, MIL-W-16878 Type EE (1000 Volts)	439 0000 Series
X		
Y		
Z	Acetate Yarn Telephone Type	428

SIZE OF WIRE CODE	
LETTER	SIZE
A	#22 AWG
B	#20
C	#18
D	#16
E	#14
F	#12
G	#10
H	#8
J	#6
K	#4
L	#2
M	#1
N	#0
P	#00
Q	#000
R	#0000
T	#28
V	#26
W	#24
X	#19
Y	#30
Z	

COLOR CODE	
NUMBER OR LETTER	COLOR
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray (Slate)
9	White
a	Clear
b	Tan
c	Pink
d	Maroon
e	Light Green
f	Light Blue

COLLINS RADIO COMPANY